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# THE IRON AGE

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# 1923 Set a Hard Pace for 1924

## Volume Not Likely to Be Equaled in 1924, but Difference May Not Be Great—Prices Rise and Fall—An Incipient Boom with Some Reaction

NINETEEN-TWENTY-THREE was one of the most spectacular years the steel trade has known. Nineteen-twenty-four probably will not rival it in that respect. The new year will be like last year in that iron and steel works will find a large demand for their products from the railroads, new construction and the automobile, ranking in the order named. But the volume of business in 1924 does not now promise to equal that of 1923, nor are profits expected to be quite as good. In neither respect, however, on a fair appraisal of what can now be seen, does the disparity between the two years promise to be great.

As 1923 opened the indications were that iron and steel plants would be well employed through the first half of the year. What came was surprisingly beyond the common prophecy. Today predictions again are limited to the first half of the new year, and are fairly favorable as to volume, but admittedly with less leeway for surprise on the side of optimism.

There were in 1923 two broad swings in production, buying and prices—one up, the other down. The upward sweep attained its peak soon after the end of the first quarter. The downward trend has been in progress, with here and there a jog or unevenness, through the last eight or nine months. The most remarkable thing about the year was that demand should have risen so rapidly in the first two or three months as to cause fears of a runaway market, and that in less than 60 days after high tide, or before the end of May, there should have been signs of reaction.

### Outstanding in 1923

*GREAT activity in buying and production in the early months of the year, with the highest pressure in April and a scramble for steel at premium prices. Cautions widely sounded and some postponement of building moderated the pace. From May to the end of the year there was a gradual slowing down.*

*Prices of pig iron and finished steel showed a difference in trend that has no precedent. Pig iron steadily declined from April to mid-November, with a total fall of $10 a ton. Leading steel products, through all the decline in pig iron, held close to the April level.*

*The year was epochal in the abolition of the 12-hour day at plants producing about 80 per cent of the country's steel. Some companies still keep the long turn, but are expected to fall in line this year.*

*Nineteen-twenty-three ranks second in steel production, with 43,250,000 gross tons of ingots, 25 per cent more than the 34,568,000 tons of 1922. The 1917 record was 43,619,000 tons. If capacity be put at 54,000,000 tons, 1923 was an 80 per cent year.*

*In pig iron 1923 made a new record at about 40,250,000 tons, a 48 per cent increase upon the 27,220,000 tons of 1922. The best previous year in pig iron was 1916, with 39,435,000 tons.*

It has been common to say that psychological influences had more to do in shaping the course of business last year than in any of its predecessors. Seemingly, buyers of iron and steel carried on their business throughout the year with one eye on the disastrous reaction of 1920 and the other on the reign of catastrophe that was bringing central Europe to the verge of destruction. The heavy losses on swollen inventories three years ago were fresh enough in mind to cause a quick response to the cautions sounded in March and April. At the same time the possibilities of harm to business in the United States from the demoralization of Europe held the average manufacturer to a conservative course.

#### Replenishment a Factor

It seems strange, now that the whole year can be seen in review, that there should have been any serious thought that activity would long keep up at the pace reached early in the spring, involving the production of ingots at the rate of 49,000,000 tons a year. Many failed to appreciate that the steel industry was still feeling the rebound from the coal and railroad strikes of 1922. The low prices of early 1922 led consumers to begin replenishing their stocks, after having worked from hand to mouth through the depressed months of 1921. The coal and railroad strikes stopped the restocking; but it was resumed late in 1922

and carried over into the early months of 1923. When the building expansion of last spring was added, and the heavy buying of the railroads, it appeared to some consumers that they were not going to get deliveries as needed. That fear proved groundless. The railroads have never functioned so well as in the past year. In the first eight months of 1923 deliveries of steel were on a scale never equaled.

### Sources of Demand

Construction on a scale greater than the country had ever seen was a large factor in the year's demand in steel, probably the chief factor, if railroad and other bridges and the various forms of concrete construction be added to the remarkable volume of building work. Railroad track and equipment steel was called for also on a large scale. Rail mills were busier than in 1922 and there was good buying of track supplies. Carworks were well employed throughout the year, though new car orders placed in 1923 were not so many as in 1922 —a total of nearly 92,000, against about 170,000 in the previous year.

Automobile production went beyond all records and the pressure upon the rolling mills from this source was especially strong in the spring and early summer months. Some motor car plants surprised steel makers with the amount of material they called for in the last quarter, when a considerable falling off had been looked for.

The oil industry, suffering in a marked degree from overproduction, did not make as great demand on the pipe mills as in 1922, but the building trades fairly compensated for the falling off. In tin plate the year was exceptional, both in the large volume of business from the canning industry and in the expansion of package and other manufacturing uses of tin plate.

Agricultural implement works operated for some months on a 65 per cent basis and for a time promised to be better buyers of steel than in 1922; but while prices of agricultural products showed some improvement, farmer buying did not increase to an appreciable extent.

The widely ramifying minor uses of steel, representing consumption by the individual buyer—those uses which bring tonnage to wire mills, strip mills and hoop and band mills—made good demands upon producers in 1923.

Foundry operations were on a scale showing a good advance upon 1922. Makers of water and gas pipe had a busy year. Municipal work was plentiful and prices went to levels on which efficient plants made good profits. Foundries supplying automobile castings and those making heating and plumbing equipment had fuller operations than others. Steel foundries, with the active buying by railroads, had the best year since the war. Jobbing foundries had varying fortunes. For many of them the average for the year was between 60 and 70 per cent of capacity.

### Production

The rate of output reached in the peak months of April and May was beyond the expectations of the most sanguine among producers of steel. The same is true of the year's output as a whole. Early in January steel works operated at about 80 per cent of the country's capacity, the effort everywhere being to make up the delivery shortages caused by the coal and railroad strikes of 1922.

Looking back on the year, it is seen as the only one of the five since the war in which there were at the same time an unusually heavy demand for steel and an operation of the mills unhampered by strikes or other interruption of the inflow of raw materials or the shipment of finished product.

There was recognized, it is true, in the first half of the year, an insufficient supply of common labor, because of the remarkable activity in outdoor work and the higher wages paid by the latter. But due to the well-directed efforts of works managers in the rearrangement of forces and in some cases to the co-operation of the workers, increased output was secured at steel plants. At one time in the first half of the year, when the Steel Corporation as a whole was running at 92 per cent of capacity, it was stated that 25,000 fewer men were employed than in 1920 when a like output was being made.

In addition to its own heavy production, the Steel Corporation rolled last year something like 300,000 tons of semi-finished steel bought from other companies. Some of this buying was done in March and at various times later round lots of sheet bars were placed with Youngstown mills. A total of 70,000 tons of pipe rounds was bought in the first quarter of the year for the National Tube Co. There was also a contract for 100,000 tons of ingots with a western Pennsylvania steel plant. This deal involved the delivery of plates to a car works connected with the steel plant.

### Fluctuations in Output

The fluctuations in steel output through the year are represented by an annual rate of 43,000,000 tons of ingots for the whole country in January, a maximum of 49,250,000 tons a year in April, and a yearly rate of about 37,500,000 tons as the average for November and December.

We estimate pig iron production for 1923 (including charcoal iron) at 40,250,000 tons. The year's steel ingot production may be put at 43,250,000 tons and that of steel castings at 1,400,000 tons, making the total of ingots and castings about 44,650,000 tons. Comparison with the seven previous years is made in the table below:

| | Pig Iron, Gross Tons | Steel Ingots and Castings, Gross Tons |
|---|---|---|
| 1916 | 39,434,797 | 42,773,680 |
| 1917 | 38,621,216 | 45,060,607 |
| 1918 | 39,054,644 | 44,462,432 |
| 1919 | 31,015,364 | 34,671,232 |
| 1920 | 36,925,987 | 42,132,934 |
| 1921 | 16,688,126 | 19,783,797 |
| 1922 | 27,219,904 | 35,602,926 |
| 1923 | 40,250,000* | 44,650,000* |

*Estimated.

The variations in pig iron production appear in the following statement of the number and daily capacity of the furnaces in blast at the beginning of each month:

| 1923 | No. in Blast | Daily Capacity, Gross Tons | 1923 | No. in Blast | Daily Capacity, Gross Tons |
|---|---|---|---|---|---|
| Jan. 1 | 253 | 101,400 | July 1 | 323 | 122,555 |
| Feb. 1 | 262 | 105,125 | Aug. 1 | 298 | 114,200 |
| Mar. 1 | 278 | 110,055 | Sept. 1 | 270 | 106,590 |
| April 1 | 293 | 115,800 | Oct. 1 | 255 | 102,100 |
| May 1 | 310 | 119,500 | Nov. 1 | 245 | 99,030 |
| June 1 | 321 | 125,100 | Dec. 1 | 231 | 94,345 |

The variations in the average daily rate of steel ingot output from month to month are shown below:

| Months, 1923 | Daily Production, Gross Tons | Months, 1923 | Daily Production, Gross Tons |
|---|---|---|---|
| January | 141,569 | July | 140,570 |
| February | 143,955 | August | 136,214 |
| March | 149,883 | September | 132,647 |
| April | 157,776 | October | 131,406 |
| May | 155,400 | November | 119,762 |
| June | 144,188 | December | ...... |

### The Year in Pig Iron

In comparing THE IRON AGE pig iron composite with the finished material composite, a striking contrast is presented, particularly as to the price ranges from spring to winter. The pig iron composite for March shows an average of $30.83, while for December it was $21.88, a reduction of $9.95. The finished steel composite for March was 2.721c. and for December 2.738c., or virtually the same. In the case of pig iron there was a steady decline from March to December.

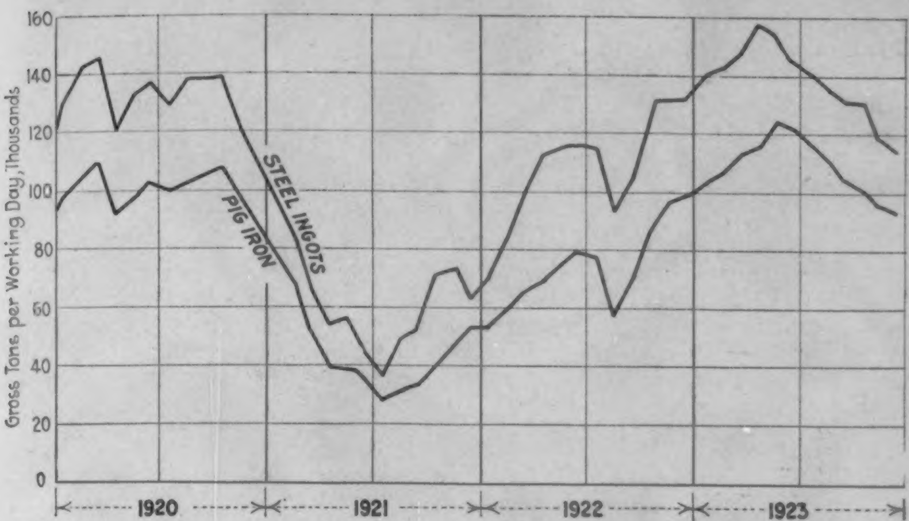



Diagram Showing the Fluctuations in Daily Average Production of Steel Ingots and Pig Iron in the Past Four Years, Based on monthly ingot statistics of American Iron and Steel Institute and monthly pig iron statistics of THE IRON AGE

The market at the beginning of the year was $25, Valley, for No. 2 foundry and was pushed up to $31, then declined steadily to $21 in December. An effort was made after the peak had been reached in March to hold the market at $31 for steel works grades and $32 for foundry, but buyers stayed out of the market and before the third quarter the price began to sag, while steel companies started to pile iron and tried to unload surplus stocks. Basic declined from $31 to $20, Bessemer from $31 to $22, and foundry from $31 to $21. Large tonnages passed into speculative hands and will probably appear some day to interfere with efforts of producers to advance prices.

Eastern Pennsylvania furnaces started the year with well-filled order books, having taken more than 100,000 tons during the final two weeks of 1922. Buying continued over the first three months, but when third quarter demand did not develop in May prices began to decline, and this was the tendency until almost the close of the year. The anthracite coal strike caused a slight advance in September, but the early settlement of that trouble left the market where it was before the strike. There was gradual weakening in the three months following until the large buying movement of late November gave the furnaces enough December and first quarter iron to bring quotations up from $21 to $23.

In the Chicago district there was activity during the first quarter of the year, with a seven months' decline beginning in April and a strong buying movement in November, with sales of fully 200,000 tons. The amount sold in the entire country in about two weeks in November was over 1,000,000 tons.

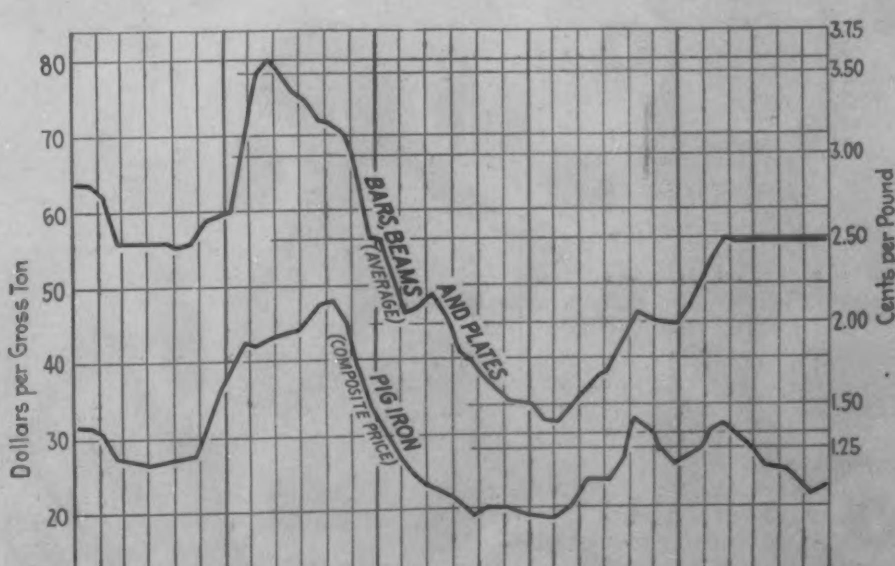
Chicago district producers found competition from outside sources keen at various times throughout the year. Canadian pig iron was sold in Michigan, Wisconsin and Minnesota. For a time in January Southern furnaces sold at prices delivered in Chicago equal to the local furnace quotation. Cleveland iron was sold in central Michigan. In September two boatloads of Buffalo iron amounting to 4500 tons were delivered at Milwaukee. In the Cleveland district the competition from Buffalo furnaces was keen, but Cleveland was a lively competitor at points distant from that city.

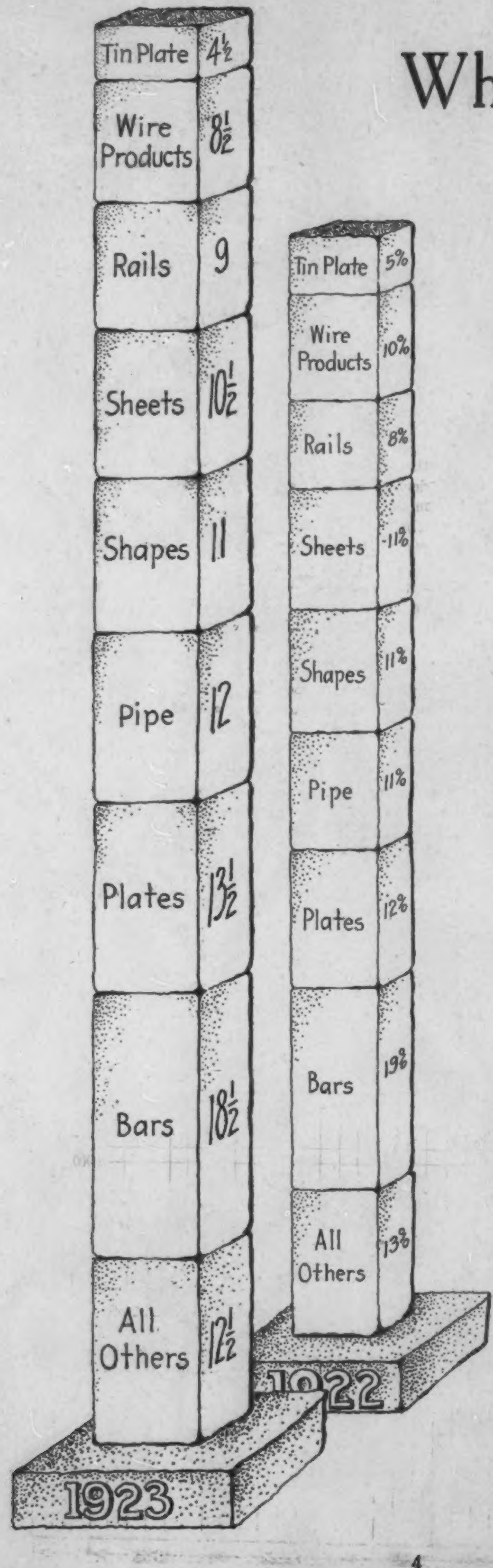
The markets at the close of the year showed little activity, but prices were fairly well maintained and the outlook for the early part of 1924 was encouraging, although it was not probable that prices would soon advance to any extent.

Importations of pig iron for 1922 amounted to 383,475 tons and for 11 months of 1923 the total was 355,465 tons, but the movement from abroad steadily decreased from 83,935 tons in January to an average of

*(Continued on page 67)*

Curves Showing Fluctuations in the Average of Bar, Beam and Plate Prices, Pittsburgh, in the Five Years 1919-23, and for the Same Years the Fluctuations in the Pig Iron Composite (Basic Iron at Valley Furnace and Foundry No. 2 at Chicago, Philadelphia and Birmingham). The chart emphasizes the decline in pig iron and the maintained price of bars, beams and plates for the greater part of 1923






# Where Steel Went in

RAILROADS took fully 27 per cent of the steel distributed in 1923. In 1922 the carriers were also the leading consumer, but their proportion then was 22 per cent of the total. Based on an analysis of the returns from 84 per cent of the ingot capacity of the country, THE IRON AGE has estimated that the total production last year of rolled steel, including forging blooms and billets, was 31,580,000 tons, or 23½ per cent more than the 25,547,000 tons of rolled steel products produced in 1922. The indicated total thus showing nearly one-quarter greater output than in 1922, the railroad absorption was accordingly one-half again more than it was in the preceding year.

As was the case in 1922, the railroads, building and general construction work, the automobile industry and oil and allied developments combined accounted for the big bulk in 1923, but while in the preceding year they took something more than one-half of the total, in 1923 their aggregate requirements amounted to nearly two-thirds of the larger production of the past year.

**What Tables and Charts Show**

It was through the cooperation of steel producers, who were asked to give the totals of each form of steel they made and also to designate, so far as possible, the channels of consumption according to a number of outstanding industries, that this analysis has been made, with its accompanying charts and tables.

The charts are proportioned to show relative volumes taken by industries and the percentages of the different forms. Besides the major charts, there is a chart on page 6 showing by industries how the different forms of steel were distributed, giving proportionately the volumes of the different forms of steel. On page 7 is a chart show-

## Production Nearly One-Fourth More Than in 1922

## Railroads Take 27 Per Cent of the Total or One-Half More Steel Than in Preceding Year

# Nineteen Twenty-Three

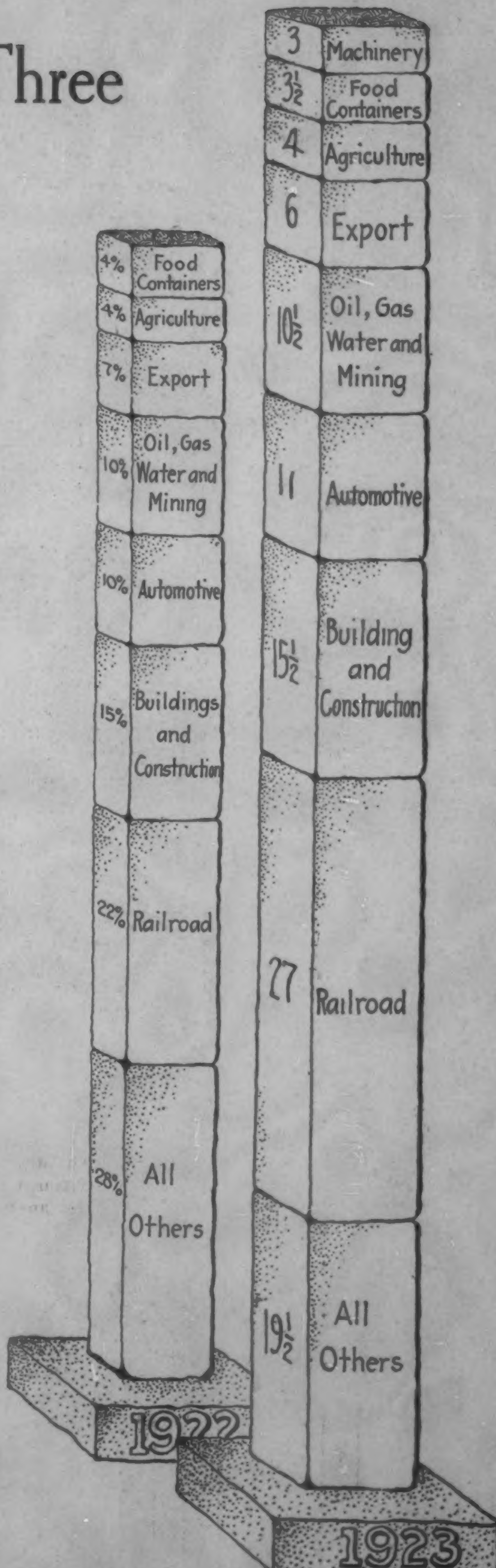
ing the percentage relation of the consumption of each product by the different industries.

In connection with each of these charts is a table showing the percentages. The table on page 6 shows for the automotive industry, for example, what percentage of the total required for automobile manufacture was supplied in the form of bars or sheets, say, and gives the percentage figures for those items which are too small to be shown in the chart. Similarly the table on page 7 shows how much of the total production of wire products, for example, was taken by the agricultural industry or by the railroads, this table likewise containing the percentages of industrial uses too small to show on the corresponding chart.

On page 8 is given a table which approximates in units of 5000 tons the distribution of steel for 1923. From this one may gather directly just what tonnage of rails was taken by the railroads or what tonnage of structural shapes was used by the building industry, or the tonnage of plates required for the making of tanks for the oil, gas, water and allied industries. Estimated totals are also shown in the table for the entire consumption of the different industries and for the entire production of the different forms of steel.

So far as different forms of steel are concerned practically no shifts occurred in relative volumes, comparing one year with the other. In 1922 the outputs of pipe, shapes and sheets were all substantially equal at 11 per cent. In the past year production of pipe represented about 12 per cent of the total, shapes 11 per cent and sheets 10.5 per cent.

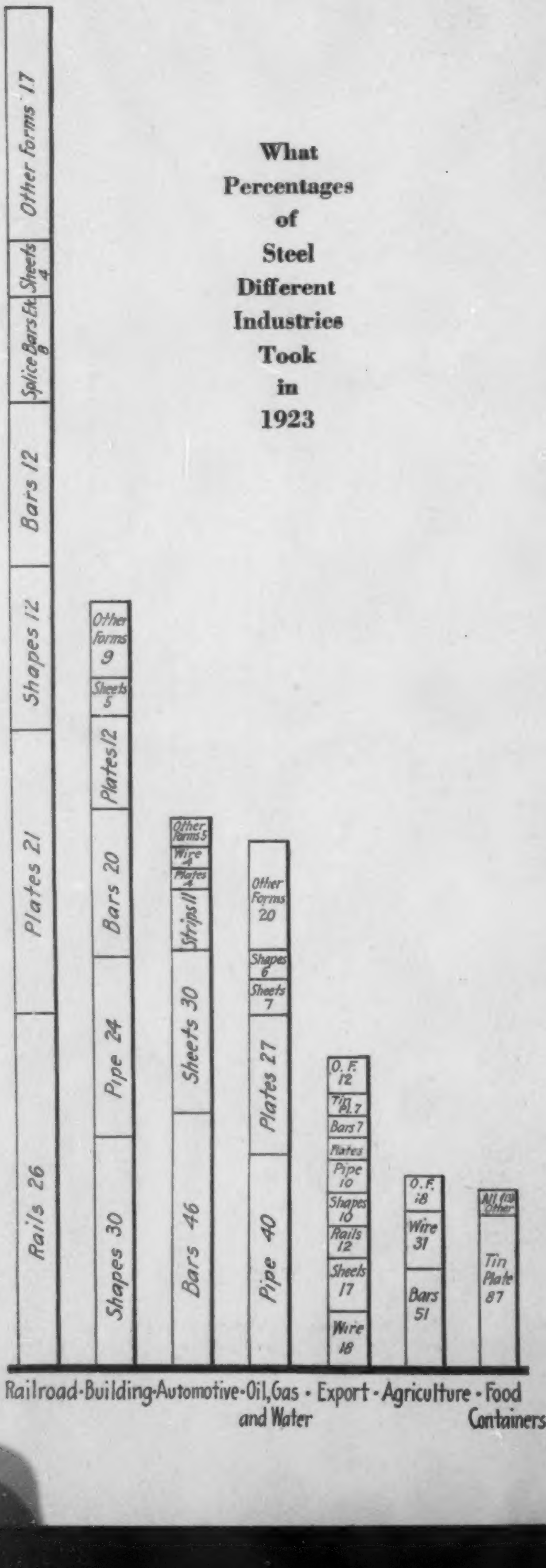
As regards relationships of consuming industries, there has been no shift, railroads leading and followed as was the case in 1922 by buildings and general construction, the




**Nearly Two-Thirds of the Steel Was Absorbed by Railroads, Building and Construction Work, Automobiles and What May Be Classed as Oil and Mining Developments**

*Forms of Steel Different Industries Took in 1923, Showing What Percentage of Each Industry's Total Each Form Constituted*

| | Rails | Splice Bars, Tie Plates, etc. | Plates | Shapes | Bars | Sheets (not inc. black plate for tinning) | Tin Plate | Wire Rods | Pipes and Tubes | Hoops, Bands, Strip Steel, etc. | Forging Blooms and Billets | All Other |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Automotive (inc. trucks, tractors, etc.) | .. | .. | 4 | 1 | 46 | 30 | .. | 4 | 1 | 11 | 1 | 2 |
| Railroads (inc. cars and locomotives) | 26 | 8 | 21 | 12 | 12 | 4 | .. | 1 | 2 | 1 | 2 | 11 |
| Agriculture | .. | .. | 5 | 2 | 51 | 5 | .. | 31 | .. | 1 | 2 | 3 |
| Bldgs., bridges and other Const. (Not R.R.) | .. | .. | 12 | 30 | 20 | 5 | .. | 2 | 24 | 1 | 1 | 5 |
| Shipbuilding | .. | .. | 37 | 27 | 19 | .. | .. | .. | 1 | .. | 8 | 8 |
| Food containers | .. | .. | 1 | .. | .. | 2 | 87 | 1 | 1 | 8 | .. | .. |
| Machinery (elec., textile, machine tools, etc.) | .. | .. | 16 | 3 | 55 | 12 | .. | 8 | .. | 2 | .. | 4 |
| Oil, gas and water | 4 | 1 | 27 | 6 | 5 | 7 | 5 | 1 | 40 | 1 | 1 | 2 |
| Exports | 12 | 1 | 7 | 10 | 7 | 17 | 7 | 18 | 10 | 1 | .. | 10 |
| Miscellaneous | 2 | 1 | 6 | 7 | 12 | 17 | 3 | 26 | 16 | 2 | 6 | 2 |




automobile industry, oil, gas, water and mining enterprises, exports, agriculture and food containers, in the order named. They all took a somewhat larger percentage than they did in 1922, save exports, but this is in part accounted for by a closer estimate of the distribution ascribed to miscellaneous uses. In 1922 in the miscellaneous classification was put 26 per cent of the total steel, while in 1923 this was reduced to 18.5 per cent.

The amount of steel consigned to jobbers was supplied by companies making about 24 per cent of the country's steel and from this it is found that the average volume of steel taken by distributing warehouses was 10.3 per cent. This jobber tonnage was subsequently allocated to the different industries as a part of the 1923 steel distribution analysis.

Definite figures received of the production of alloy steel bars did not total over 375,000 tons. Of this about 85 per cent appears to have gone to the automobile industry.

The heavy tonnage products in 1923, plates, sheets and bars, account for 43 per cent of the total against 42 per cent for 1922.

Details of the production of concrete reinforcing bars have not been received in sufficient volume to make an estimate for the whole country. In the territory served by Chicago mills and including the output of rail steel mills sales in 1923 are estimated at between 180,000 and 190,000 tons.

The capacity of the steel sheet industry has increased from the standpoint that there are now 674 hot mills in the United States against 668 earlier in 1923. Using the statistics of the National Association of Sheet and Tin Plate manufacturers, the indicated distribution of sheets as tabulated in this analysis is over 10 per cent too low, measured by both production and shipments compiled and announced monthly by the association.

### The Railroad Consumption

In addition to large tonnages of rails and track accessories and the miscellaneous requirements for shop work and road maintenance, the railroads ordered 91,952 freight cars last year, but what is more important from the standpoint of steel consumption is that they received from the car builders a total of 149,878 cars, a considerable part of which were of course contracted for in the latter part of 1922. The railroads also received from the car builders 51,650 freight cars which had been repaired, this figure being based on deliveries up to Dec. 1 of 47,950 cars and an estimated delivery in December of 3700 cars. Orders placed for the repair of cars during the year reached more than 35,000, the total up to Dec. 1 having been 34,542.

*How Each Form of Steel Was Distributed in 1923 Among the Industries*

| | Automotive | Railroads | Agriculture | Buildings and Const'n | Shipbuilding | Food Containers | Machinery | Oil, Gas, Water and Mining | Exports | Miscellaneous |
|---|---|---|---|---|---|---|---|---|---|---|
| Rails | .. | 82 | .. | .. | .. | .. | .. | 4 | 9 | 5 |
| Splice Bars, etc. | .. | 90 | .. | .. | .. | .. | .. | 3 | 3 | 4 |
| Plates | 3 | 43 | 1 | 14 | 3 | .. | 4 | 21 | 3 | 8 |
| Shapes | 1 | 30 | 1 | 42 | 2 | .. | 1 | 6 | 5 | 12 |
| Bars | 28 | 18 | 10 | 17 | 1 | .. | 9 | 3 | 2 | 12 |
| Sheets | 31 | 11 | 1 | 7 | .. | 1 | 3 | 7 | 10 | 29 |
| Tin Plate | .. | .. | .. | .. | .. | 67 | .. | 13 | 10 | 10 |
| Wire Products | 5 | 2 | 14 | 4 | .. | .. | 3 | 2 | 13 | 57 |
| Pipe and Tubes | 1 | 4 | .. | 31 | .. | .. | .. | 35 | 5 | 24 |
| Hoop, bands, strip steel, etc. | 51 | 3 | 2 | 7 | .. | 11 | 3 | 5 | 2 | 16 |
| Forging billets and blooms | 5 | 24 | 4 | 4 | 4 | .. | .. | 4 | .. | 55 |
| All other | 4 | 54 | 2 | 16 | 1 | .. | 2 | 3 | 11 | 7 |

The situation in 1923 in car building reversed that of 1922. In 1922 the number of cars built was about 65,000, less than half the number built in 1923, but the orders that year were in excess of 170,000 as compared with the 91,952 in 1923. Therefore, from the standpoint of use of steel 1923 was a more important year in rehabilitation of railroad rolling stock than was 1922.

Cars delivered to the railroads in 1923 were made up of the following types:

| Type of Car | Number Built* | Average Tons of Steel Per Car | Total Steel Used Net Tons |
|---|---|---|---|
| Box | 57,133 | 9 | 514,197 |
| Flat | 1,910 | 10 | 19,100 |
| Stock | 2,521 | 10 | 25,210 |
| Gondola | 23,947 | 14 | 335,258 |
| Hopper | 39,555 | 17 | 672,435 |
| Tank | 7,719 | 15 | 115,785 |
| Refrigerator | 12,219 | 10 | 122,190 |
| Caboose | 354 | 9 | 3,186 |
| All others | 4,520 | 15 | 67,800 |
| Total | 149,878 | | 1,875,161 |

*December deliveries estimated.

It is estimated that an average of five tons of steel per car is used in such car repair work as is done by the car builders. Therefore the estimated total of 51,650 cars repaired during the year in car building shops, exclusive of shops owned and operated by the railroads, required additional steel amounting to 258,250 tons, or a total for the year upward of 2,150,000 tons.

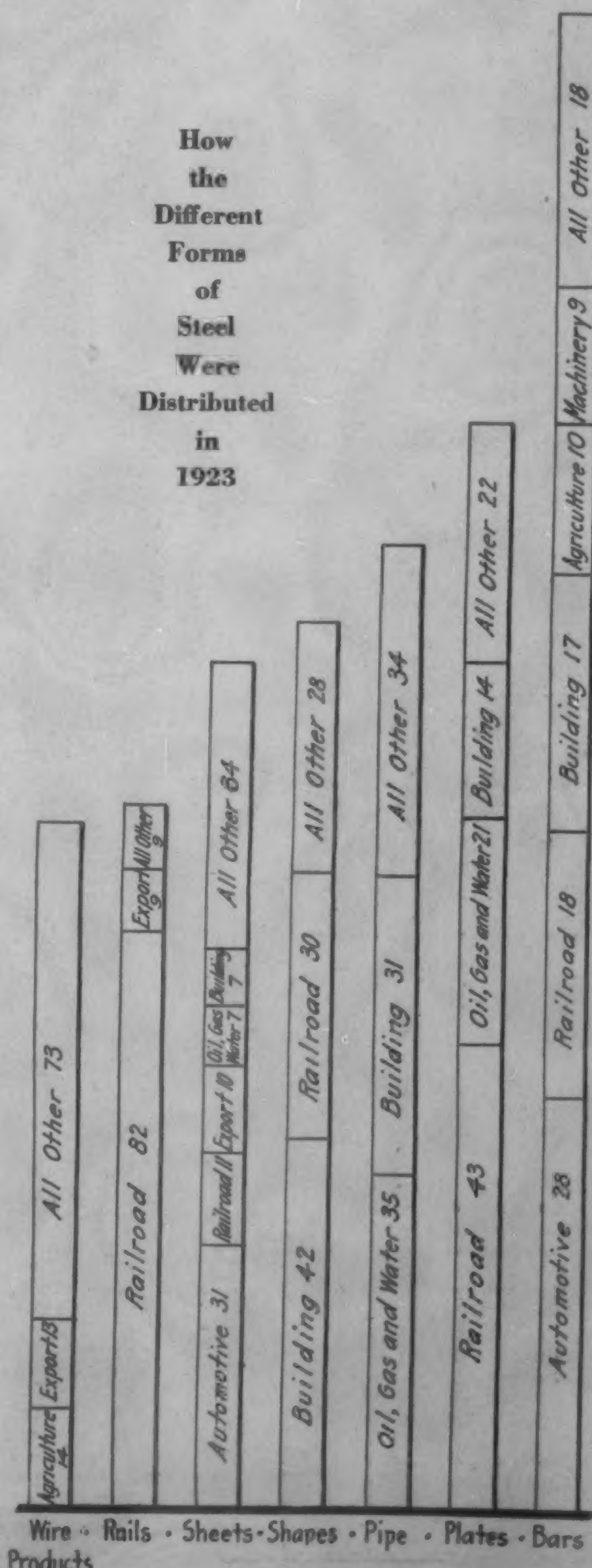
During 1923 orders were placed by the railroads for the following types of equipment:

| | |
|---|---|
| Box cars | 35,456 |
| Flat | 1,530 |
| Stock | 1,000 |
| Gohdola | 12,389 |
| Hopper | 26,143 |
| Tank | 4,315 |
| Refrigerator | 5,600 |
| Caboose | 453 |
| Others | 5,066 |
| Total | 91,952 |

Foreign orders for cars during the year were almost negligible. Only 1801 cars for foreign shipment were built, and these are not included in the above tabulation.

Based on figures of the car service division of the American Railway Association, it is estimated that about 4000 new locomotives were placed in service by the railroads in 1923. Of these 3704 had been delivered up to Dec. 1. Assuming that each locomotive took an average of 100 tons of steel—some of the large types take considerably more—the total of steel consumed for locomotive building during the year would reach 400,000 tons.

A statement issued by the American Railway Association says that capital expenditures for equipment



and other facilities in 1923 by the railroads of the country totaled $1,075,897,940, compared with $429,272,836 actually expended in 1922. In addition there was carried over into 1924 authorizations made in 1923 capital expenditures amounting to $300,806,519. This makes a total of $1,805,977,295 expended or authorized for capital improvements during 1922 and 1923.

Class I railroads in 1923 also expended for fuel, materials and supplies used in current operation and maintenance approximately $1,800,000,000 compared with $1,668,573,271 in 1922. This amount was expended in addition to expenditures made on capital account for increasing facilities made almost entirely from borrowed money.

This means a total of $3,176,704,459 representing capital expenditures or authorizations in 1923 for increasing facilities plus expenditures in that year for fuel and materials and supplies used in current operation and maintenance. This amount has gone to the industries of the country and represents one of the main reasons for the expansion of business and large employment of labor during the past year.

### Building Construction in 1923

Figures compiled by the Department of Commerce for the first 11 months of the year and estimated for the final month indicate that the total of fabricated steel placed under contract in 1923 will have reached not less than 1,850,000 tons, which is a gain of several hundred thousand tons over 1922.

Further indication of the importance of building construction as a factor in the 1923 steel demand is afforded by figures of the F. W. Dodge Corporation, New York, based on its returns from States which normally give seven-eighths of the construction volume of the United States. These figures show that the total of building construction in the country in the past year was $4,400,000,000, falling short of the 1922 record by only $100,000,000.

Although a large part of the building construction work was placed under contract in the first six months of 1923, the decline from the peak was gradual and the F. W. Dodge Corporation concludes that "it seems likely that the low point of the present cycle will not be reached until some time in 1924."

Recently there has been quite a gain in the issuance of building permits. The National Monthly Building Survey, published by S. W. Straus & Co., reported recently that November showed a greater volume of building permits for the entire country than any previous November, and it was the third highest month of 1923. Twenty-five cities representing 50 per cent of the nation's building activity issued permits in November for building construction that will total $214,408,114. New York, where about 15 per cent of the entire country's building operations are going forward, reached nearly $100,000,000 in building permits in November.

The Dodge corporation, which a year ago estimated the 1923 building expenditure would reach $3,750,000,000—a figure which fell $650,000,000 below actual performance—now estimates that there will be a continuance of building on a large scale in 1924 and that the total for this year will reach $4,000,000,000, only 9 per cent below last year's phenomenal record.

### Automobile Steel Increased 35 Per Cent Over 1922

Automobile production reached such a high mark in 1923 that the record-breaking output of 1922 was dwarfed by comparison. A statement given out this week by the National Automobile Chamber of Commerce shows a total of cars and trucks for 1923 of 4,014,000, of which 3,644,000 were passenger cars and 370,000 were trucks. In 1922 the total production was substantially 2,600,000, of which 2,339,768 were passenger automobiles and 246,281 were trucks.

A considerable part of the increase in automobile output in 1923 was due to larger production by the Ford Motor Co., which in 1922 manufactured about 40 per cent of the total number, but which in 1923, it is estimated, made 50 per cent of the total.

Directly or indirectly the automobile industry has taken a very important share of the 1923 output of finished steel. In 1922 it was estimated by THE IRON AGE that the manufacture of automobiles and trucks accounted for fully 10 per cent of the 26,452,004 gross tons of finished iron and steel produced in 1922, and it took 11 per cent of finished steel output of 1923. This last being 23½ per cent greater than the 1922 output, the automotive industry consumed fully 35 per cent more steel in 1923 than in the year preceding.

## ESTIMATED CONSUMPTION OF STEEL IN 1923

*(Thousands of Tons)*

Approximate Amount of Each Form Taken by Each of a Number of Industries

| | Rails | Splice Bars, Tie Plates, etc. | Plates | Shapes | Bars | Sheets (not inc. black plate for tinning) | Tin Plate | Wire Rods | Pipes and Tubes | Hoops, Bands, Cotton Ties, Strip Steel, etc. | Forging Blooms and Billets | All Other | Totals |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Automotive (inc. trucks, tractors, etc.) | .... | .... | 130 | 40 | 1,610 | 1,035 | .... | 135 | 40 | 400 | 20 | 60 | 3,470 |
| Railroads (inc. cars and locomotives) | 2,300 | 720 | 1,840 | 1,055 | 1,050 | 345 | .... | 55 | 130 | 20 | 155 | 920 | 8,590 |
| Agriculture | .... | .... | 55 | 25 | 605 | 55 | .... | 375 | .... | 20 | 30 | 35 | 1,200 |
| Bldgs., (bridges and other const., not R.R.) | .... | .... | 590 | 1,435 | 900 | 235 | .... | 105 | 1,160 | 55 | 25 | 270 | 4,865 |
| Shipbuilding | .... | .... | 110 | 85 | 60 | .... | .... | .... | 5 | .... | 25 | 25 | 310 |
| Containers (principally food) | .... | .... | 10 | .... | 5 | 25 | 960 | 10 | 5 | 85 | .... | .... | 1,100 |
| Machinery (elec., textile machine tools, etc.) | .... | .... | 155 | 25 | 515 | 110 | .... | 80 | .... | 20 | .... | 35 | 940 |
| Oil, gas, water and mining | 120 | 25 | 895 | 205 | 165 | 235 | 180 | 45 | 1,340 | 40 | 25 | 55 | 3,330 |
| Exports | 240 | 20 | 135 | 190 | 145 | 335 | 140 | 345 | 185 | 20 | .... | 190 | 1,945 |
| Miscellaneous | 125 | 25 | 360 | 420 | 715 | 955 | 145 | 1,540 | 935 | 130 | 350 | 130 | 5,830 |
| Totals | 2,785 | 790 | 4,280 | 3,480 | 5,860 | 3,330 | 1,425 | 2,690 | 3,800 | 790 | 630 | 1,720 | 31,580 |

# Industrial Village on Sound Basis

## Development of Confidence of Foreign Employees Achieved Through Study of Their Requirements and Tact in Handling Them

WHEN the Kinkora Works was established by John A. Roebling's Sons Co. in 1904, there were no living quarters immediately adjacent. To take care of the growing list of employees, largely of foreign birth, "The Village" was established on a small scale that year. Located on a bluff some 50 ft. above the level of the Delaware River on the New Jersey side, and commanding, from the park along the river edge, a view for several miles both up and down stream, the site 20 years ago was farmland, being covered partly by an old apple orchard but mostly by fields of lima beans. Growth of the village has kept pace with that of the works which it serves, until today there are 767 houses and a population of approximately 4000, of whom some 70 per cent are foreigners.

Unlike many other developments of similar character, the entire village remains the property of the company, which has installed a real estate department in the bank building to take care of the houses and other property and the manager of which, R. H. Thompson, is virtually "city manager." Colloquially he is called the "mayor," although the village has not been incorporated. But there falls on his shoulders the task of handling all matters between the residents and the company, and all such civic operations as water, electricity and gas supply, garbage disposal, supervision of the several amusement enterprises, street cleaning and park care.

Approximately 190 acres are comprised within the site, of which 150 acres are available for use, the remainder being river bottomland which is now in process of being filled in and which, eventually, will become a portion of the riverfront park. Situated at the bottom of the steep bluff, this will form an ideal location for an amphitheater, and here will be located the athletic field. This is now in the western end of the village, near the school building, with stands accommodating about 1500 spectators.

### Town Built to Last

Substantiality seems to be the keynote of the whole enterprise. All the houses are of brick, or brick and stucco. So are the stores, the school, the amusement hall, the bank, the post office and hospital and other buildings. Only such structures as are likely to be moved at a later date are built of timber. This includes the bowling alley, a small photograph gallery, etc. Even the "woodsheds," on the rear of many of the houses, particularly those en-bloc, are being given a coat of stucco.

Rents are so much lower than for similar accommodations elsewhere within reach that, as the village will not hold all of the employees, there is a constant waiting list. It thus becomes possible to make a certain selection of tenants, with regard both to permanence of employment and congeniality. Whenever a house becomes vacant the manager confers with the mill superintendents with regard to the several applicants for it. That man who has the best mill record, and is most likely to remain a fixture in the plant, obtains a definite preference.

To one accustomed to city rent figures the rents charged in the village appear to hark back to the low-price conditions of a generation ago. Six-room houses, en-bloc, bring $13 to $15 per month, the higher figure being for the end houses. Double or "semi-detached" houses of six rooms bring $16. Larger semi-detached houses of somewhat older date but with nine rooms, rent for $18. All of these houses have baths, and running water, filtered, is furnished free. The double houses have steam heating plants and are piped for gas and wired for electricity, but the tenant pays for his coal, gas and electricity, all

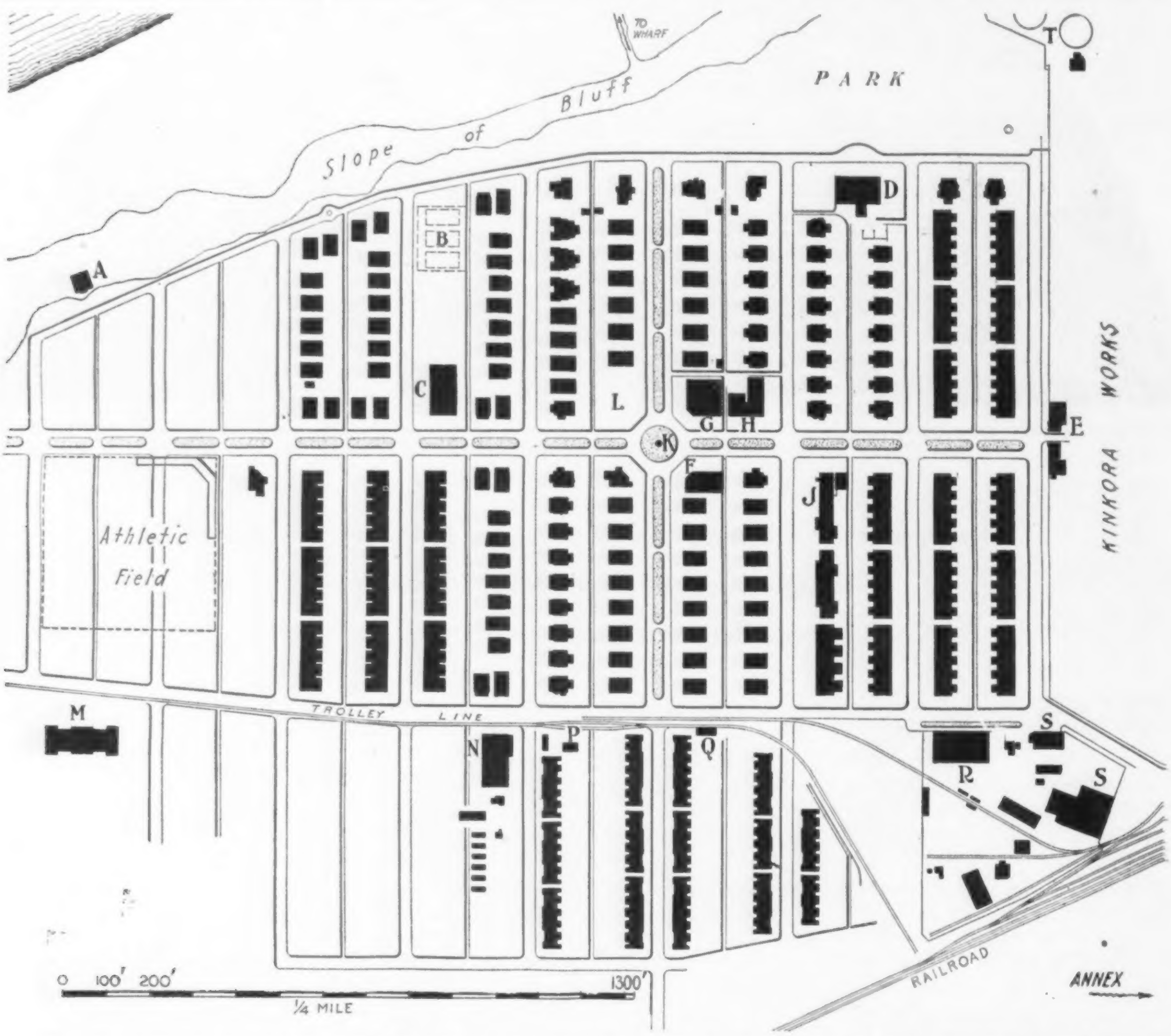
of which are furnished by the company. Current from the electric plant in the mill is supplied at 6c. per kwhr.

### Houses for Employees Only

No one can rent a house in the village unless he is an employee of the Roebling company. On the other hand, no employee is required to live in the village. There is a group of houses and stores near the railroad station, which is not on the company's property and not under its control. Here live some of the employees, partly from choice, partly from inability to find a vacancy within the village. Here also live others catering to both employees and non-employees. And this outside community has raised several serious problems in control both of radicalism and of liquor.

Again, some of the employees, coming from homes as far away as Trenton (10 miles north) or Burlington (8 miles south) prefer to retain their old domiciles and to commute. Railroad, trolley line and bus make inter-communication easy, and there are several small towns in between, each of which houses some of the workers in the Kinkora plant. But about 1400 employees are included within the village population, their families accounting for the rest.

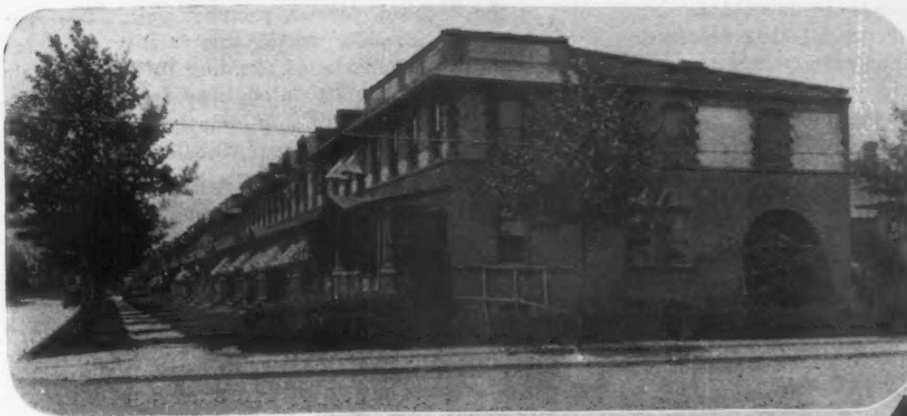
Consisting largely of foreigners, mainly Hungarians and Roumanians, the village has many children. To care for these a 16-room school near the southwest corner of the property was built by the township on land donated by the company. As the school is overcrowded with its present 1100 pupils, an addition of 9 to 12 rooms is to be erected. Teachers are hired by the township school board and come under the control of the State board of education. There are four churches, easily accessible but outside the village line. One of these maintains a parochial school, with more than 100 children in attendance.




Roebling Village, on the New Jersey Side of the Delaware River, Ten Miles South of Trenton. Expansion will take place in the west and southwest areas. There is an annex, east of the south (bottom) of the map, containing 120 houses, in blocks of ten. The railroad station is just off our map, near the corner of the annex. Garbage incinerator and sewage disposal plant are on the river bank, off the map at upper left. The letters on buildings of the village refer to the following: A.—Boy scout hut. B.—Tennis courts. C.—Amusement hall and library. D.—The Inn. E.—Main entrance to works, at end of Main Street. F.—First National Bank. G.—Department store. H.—Bakery, drug store, barber shop. J.—Post office, hospital, small stores. K.—Water tower, at junction of Main Street and Fifth Avenue, both of which are "parked." L.—Site for future furniture and dry goods store. M.—School, to be enlarged at once. N.—Recreation building—billiards, pool, bowling. P.—Photographic gallery. Q.—Trolley station. R.—Stable. S S.—Garages. T.—Gas plant.

### Where the People Buy

As Trenton is only 10 miles away, and Philadelphia only 25, many of the villagers do much of their shopping in one or the other of those cities. To accommodate local trade a department store is maintained in the central square, where a complete line of goods



Trees, Hedges, Shrubs, Vines and Flowers Abound. A contest transformed back yards into bowers of blossoms

Blocks of Ten Houses In a Row (Above and at Right)

All the Streets Are Wide—Some More So Than Others

These Houses Are of the Double or Semi - Detached Type, Each Side Having Six to Nine Rooms and Bath (Above, At Right and Below). Note the parked streets

is carried. One-half of the store is devoted to dry goods and notions, with kitchen utensils and furniture upstairs, while the other side comprises large grocery and butcher and bakery departments. The bakery, in an adjoining building, keeps nine people busy. On the next corner is a drug store, now being enlarged, and the barber is adding two more chairs, making six in all.

But no one has to buy at the "company store." In addition to the city stores at some distance there are the stores near the station, which get a good deal of the village trade. And many hucksters come in, particularly neighboring farmers and market gardeners with provisions. So long as these people behave themselves they are encouraged, for it is felt wise by the management to avoid all appearance of constraint. And this idea pervades the whole theory of the control: Let each man live where and how he wishes; let him buy where he wishes; let him do with his time as he wishes.

Having to deal so largely with a foreign element, this method has been found essential. It avoids the raising of that suspicion with which the average newcomer appears to regard our American way of doing things. It prevents him from feeling that the company is "keeping tabs" on him, both in the mill and out. And it gives him that liberty of action and choice which are essentially his if he is to become a worthwhile citizen.

This does not mean that necessary control is not exercised. In several cases it has become imperative to get rid of radicals who had come in and were stirring up trouble. Residents of the village are not permitted to harbor such elements and, when they have done so, they had to leave the village, taking the radicals along. This is one of a number of ways in which complete control of the physical entity of the village enables the management to free it from trouble.

### Providing for Activities Outside the Mill

Participation in sports is encouraged, particularly for the young men, as a means of "letting off steam" and avoiding the effects of their having too much time on their hands. Baseball teams from the different mill departments and a village football team have been developed and intense rivalry with similar teams from adjoining plants and towns has come into being. The tennis courts, maintained by the village, are in active demand. For rainy evenings there is the bowling alley, where a charge is made of 10c. per game, as a means of making each player appreciate what he is getting. And in this same building are a billiard table and nine pool tables, with a lunch room at one side.

There is an amusement hall with moving picture outfit. This seats 800 on the main floor and another 100 in the balcony. The stage is adapted for plays and entertainments, and there are dressing rooms on each side. Dances and socials are held here, the chairs being stored temporarily on the stage, back of the curtain. Appropriately enough this curtain carries a picture of the Brooklyn Bridge, upon the building of which the first fame of the Roeblings was founded. Back of the balcony is a large room devoted to a circulating library, with 4300 well-selected volumes covering a wide variety of books—not only fiction but history, science, poetry, biography, religion, etc. The total circulation for the past 12 months was 22,157 volumes, or 72 for each of the 308 days the library was open.

In the post office building is a well-equipped hospital, a new X-ray machine being the most recent piece of apparatus. Two two-bed wards, operating room, dressing room, bath, etc., with a nurse constantly in attendance, and with two doctors, each having an office in the hospital, form a compact unit. The men are encouraged to make use of this facility, even for slight injuries, as a means of avoiding infection. Their families also are accommodated here for such treatment as they may require. As this is essentially an emergency hospital, cases requiring extended treatment are taken in the company's ambulance to the large hospital in Trenton.

### Caring for Workers' Savings

Formerly the "stocking bank" or its equivalent, translated into many languages and many quaint customs, was much in evidence. And it took a long time to gain enough of the confidence of the foreign element to induce them to make use of a more secure way of taking care of their savings. But now the First National Bank, located in the center of the village, has nearly 2000 accounts and a deposit roll amounting to $875,000. Nearly all of the depositors can write, but some 25 of them are identified by the finger-print method. The stock of the bank is well distributed among employees, who are substantially represented upon the board of directors.

Arrangements are now being made to start the second series in the building and loan association. Several houses have been erected from the proceeds of the first, and the amount coming in has all been put to work in this way, a balance of only $10 remaining in the treasury. These houses, of course, are outside the company's property. There were about 950 numbers in the first series.

### Studying the Alien Psychology

Among the activities carried on by the company in the village are sewage disposal and garbage handling. Septic tanks in the flats at the lower end of the property discharge into the river. The garbage is incinerated on the river bank. In former years it was difficult to make the foreign inhabitants understand the need for keeping their yards clean; in particular, they would dump garbage in piles. To overcome this a contest was started, with substantial money prizes, for the best looking back yards. This resulted in transforming the erstwhile dumps into luxuriant gardens, and the idea "stuck."

This is merely one instance of the psychology used and tact exercised in dealing with the alien element. Their characteristics have been studied and their wishes are respected in every way which is not detrimental to the village. They are fond of being photographed, particularly with grandiose backgrounds. Hence the photographic gallery is run by one of them who understands their idiosyncrasies and their language.

Two men from the mill run the "movie." The rent they pay scarcely suffices to heat the building. But they are given virtually a free hand in providing entertainment, being made to understand at the outset that clean plays only will be allowed. Occasionally an education film is used, sometimes with a lecturer, but for the most part the men's own selections prevail.

Much influence on the older people is exercised through the children. Alert, keen, mischievous, they make it needful to keep many things locked up. But what they learn in school, at the "movie," in the library, is much of it faithfully transmitted—translated, of course, into the foreign tongue—and its effect is seen. This cannot be measured in any way, but the second-hand influence thus exerted has taught the management the importance of keeping "on the right side" of the youngsters.

### Community Services

For fire service the high-pressure fire pumps in the plant are started up as soon as an alarm is rung. Men from the mill, paid a little more for being at

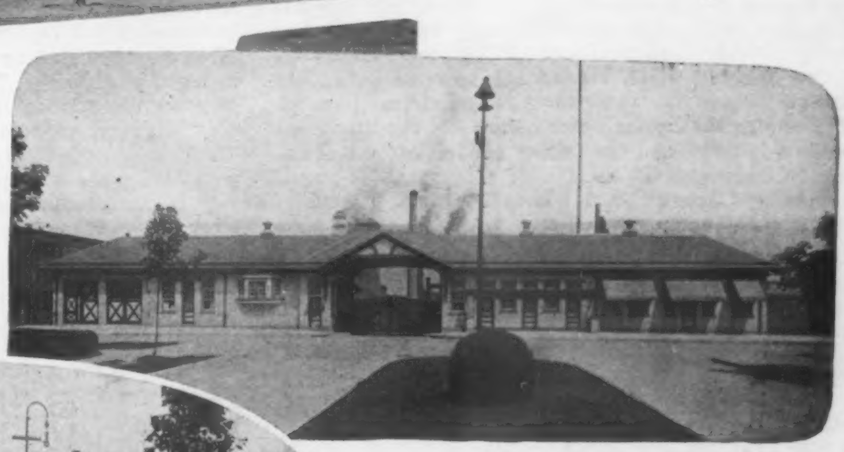
Open Spaces Give Ample Elbow Room. There is not the slightest suggestion of crowding. And there is room for considerable expansion

The Riverside Park

A Superintendent's House

"The Inn"

The Amusement Hall, Where Moving Pictures Are Shown and Dances and Socials Take Place. On the second floor, the library occupies the front



Main Entrance to the Kinkora Works, Showing the End of the Parked Main Street. At left are the principal store buildings, with the water tower at junction of Main Street and Fifth Avenue

call, day or night, comprise the fire-fighting force, under a captain. This water system, not being filtered, is piped separately, although in emergency it may be supplemented by the village supply. The latter, filtered and provided from the mill, is carried in two elevated tanks, of 92,000 and 120,000 gal. capacity.

Every effort is made to keep the streets and lawns attractive. The two streets crossing at the central square are parked down the center and are 120 ft. wide; the other streets are 80 ft. Trees have been planted, as well as shrubs in the parked spaces, and the grass is kept cut by the man in charge of streets and park. He has a small experimental plot where he can raise shrubs and other plants for eventual transplanting into the park or elsewhere.

### Does It Pay?

Inevitably the question will be raised: Does it pay?

Not in dollars and cents. As a matter of fact, the running expenses almost exactly balance the income—in many years creating a deficit which the company has had to underwrite. And this makes no provision for either depreciation or amortization. Hence the enterprise is operated at what is, in last analysis, a distinct loss—measured in money.

But it most assuredly does pay in the larger sense. It pays in attracting men of the better kind. It pays in promoting permanence of employment, and hence avoiding costly labor turnover. It pays in promoting health of employees, and thus reducing absences and errors and accidents. And Mr. Thompson, who has been with the project since its inception, and who lived that first winter in a little shack on the property, believes that through it the company has made a long step forward, not only in solving a bothersome labor problem, but also that twin problem of the assimilation into our body politic of the foreign element which forms so large a share of what we have become accustomed to call "common labor."

# Ingot Production and Unfilled Orders

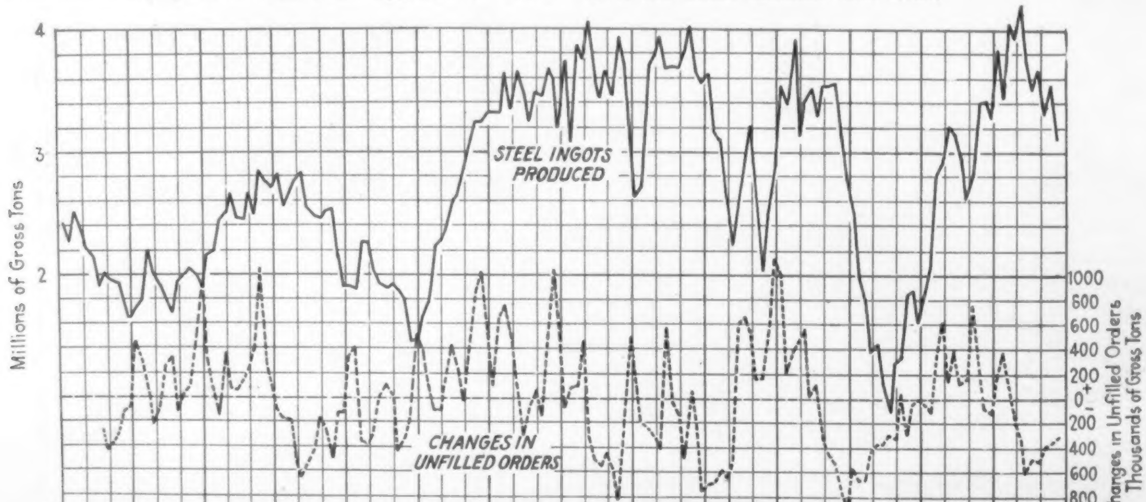
IN an attempt to trace over the past 14 years the relation between unfilled orders of the United States Steel Corporation and the production of ingots month by month in the United States, the accompanying diagram has been prepared. This shows in the upper curve the month by month ingot output, which reached a maximum of more than 4,000,000 tons on four different occasions—May, 1917, October, 1918, March, 1923, and May, 1923. The sharpness of the depression in 1921 is illustrated by the precipitous fall from a production of more than 3,500,000 tons of ingots in October, 1920, to a production of less than 1,000,000 tons in March, 1921.

In the lower curve will be found the monthly changes in unfilled orders of the Steel Corporation. Reductions are shown by points on the curve below the axial line, while increases month by month appear above that line. Incidentally, this curve shows how violent some of the fluctuations have been, particularly when we find four cases where the change in the monthly total of unfilled orders was more than a million tons in each instance. All of these cases were increases in the total, they having occurred in October, 1912, November, 1915, November, 1916, and December, 1919. The largest single reduction in unfilled orders came in December, 1920, with about 900,000 tons, November having provided practically 800,000 tons reduction.

One feature which stands out prominently in the juxtaposition of the two curves is the virtual parallelism between the falling order balance of the Steel Corporation in 1920, and the falling production line of the country, beginning in the fall of that year. It should be noted, of course, that while the curve of unfilled orders in the early part of that year appears to show a fall, this condition should be studied carefully, for what is actually shown is a declining rate of increase. It is only in the latter half of the year that a fall is actually shown, beginning with the figure for August, although in June the increase was very small. This decline in unfilled orders continued uninterruptedly from August, 1920, until the slight increase shown in September, 1921. All through this period, with the exception of the first three months thereof, there was a practically steady decline in ingot output. It should be noted, however, that the fall in orders anticipated the fall in production by about three months.

On two previous occasions a similar rapid fall in orders had anticipated a sharp fall in production, these occurring in 1917 and 1918-19 respectively. In the former case, the anticipation was by a matter of nine months, while in the latter instance it was about three months. The accumulated decrease in unfilled orders in 1917 aggregated 3,286,000 tons; in 1918-19 it was 5,196,000 tons; in 1920-21, 6,867,000 tons. In the present movement the decrease to Nov. 30 has aggregated 3,036,000 tons.

Arguing from these premises it might be supposed that the present reduced volume of unfilled orders—a reduction which has been constantly maintained month after month beginning with April—may presage a drop in ingot production. There has, it is true, been a drop of some dimensions since the high point reached last May, although present output is still on a large scale. The general consensus of opinion, however, among those who have made a business of feeling the pulse of business is that production generally is to remain at a high level for some months into 1924.



# Tying Gray or White Cast Iron in Knots

## Radical Transformation Effected by a New but Simple Heat Treatment—Machinability a Feature—Other Remarkable Properties

BY BRADLEY STOUGHTON*

THE annealing of cast iron is logically divided into two branches: The annealing of gray cast iron, and the annealing of white cast iron, with which we are all familiar in the manufacture of malleable cast iron. The distinguishing characteristic of annealing for malleable cast iron is the length of time required by the process, usually occupying at least 2½ days at temperature, not including heating thereto and cooling therefrom.

Many attempts have been made to shorten this annealing process, but without accomplishing the desired results. A distinguishing characteristic of cast iron annealed by this process is the decarbonization of the metal which, in America, is confined chiefly to the outer surface and makes what is known as "black heart malleable cast iron"; while, in Great Britain and Europe, thin castings are decarbonized to the center and make what is known as "white heart malleable cast iron." Another characteristic of this malleable cast iron, which has been recently studied by W. R. Bean,[1] and by the U. S. Bureau of Standards,[2] is its tendency to "revert" on heating and accelerated cooling; that is to say, it loses its black heart appearance and takes on a steely or crystalline fracture.

Several attempts have also been made to anneal gray cast iron for the purpose of improving its machining qualities, increasing its toughness and eliminating hard spots. These experiments have always demonstrated a great deterioration in the strength of the cast iron. Indeed, the loss of strength is usually from 50 to 80 per cent. One of the most comprehensive studies of this type of annealing was published by Harper and McPherran.[3] The research included the question of the correct time and temperature for annealing, as well as the effect on the physical properties of slow and rapid cooling. Test bars were annealed at various temperatures from 500 to 1600 deg. Fahr. (260 to 871 deg. C.). It would appear that the critical temperature of cast iron of the analysis used was between 1150 and 1200 deg. Fahr. (621 and 649 deg. C.), because heating up to 1150 deg. Fahr. produced practically no change in hardness; heating for a long time above this temperature decreased the hardness as well as the strength, while annealing at 1450 to 1550 deg. Fahr. (788 to 843 deg. C.) resulted in a decrease in hardness as well as a serious loss of strength.


Fig. 1 (A).—White iron rod, annealed; twisted and coiled hot.
Fig. 2 (B).—White iron rod, annealed; bent and twisted cold; lower end hammered out cold.
Fig. 3 (C).—White iron rod, annealed; knotted hot.
Fig. 4 (D).—Gray cast iron piston ring, annealed; coiled hot.
Fig. 5 (E).—Gray cast iron piston ring, annealed; distorted cold. This ring can be bent backwards and forwards several times without breaking.

Two other investigators,[4] working independently of one another in Germany, have confirmed in a general way these results of Harper and McPherran. They do not truly anneal, but confine their practice chiefly to heating cast iron for a long time at temperatures just below the critical range, for the purpose of decomposing the cementite in the pearlite. Other authorities might be cited, but enough has doubtless been said to confirm the following comment by Hatfield,[5] "Sufficient has now been said to demonstrate the action of annealing on the structure of gray cast iron." It "inevitably leads to weakening of such material."[6]

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*Professor in charge, department of metallurgy, Lehigh University, Bethlehem, Pa.

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[1] Am. Inst. of Min. & Met. Engs.; February meeting, 1923.
[2] Annual report, Dr. George K. Burgess, Director Bureau of Standards, 1923. Abstr. in THE IRON AGE, Dec. 20, 1923, p. 1644, vol. 112.
[3] J. F. Harper and R. S. McPherran, Allis-Chalmers Mfg. Co., Milwaukee, Amer. Fdymen's Assoc., June meeting, 1922; THE IRON AGE, Oct. 19, 1922.
[4] E. Piwowarsky, *Stahl und Eisen*, vol. 42, Sept. 28, 1922, pp. 1481 to 1483. Schüz, *Stahl und Eisen*, vol. 42, Sept. 28, 1922, pp. 1484 to 1488.
[5] W. H. Hatfield, "Cast Iron in the Light of Recent Research"—London and Phila, 1918, p. 123.
[6] Idem. p. 124.

The annealing of gray cast iron has five objects, namely, giving to the iron:

1. Better machining qualities, including the elimination of hard spots and softness without toughness under the tool. Ninety per cent of previous practice probably had this end in view;

2. Softness and anti friction qualities for bearing service, or where two surfaces are rubbed together, as in the operation of piston rings;

3. Pliability and malleability, so that the material may be distorted cold without fracture, may withstand shocks and blows without breaking, and may be hammered into a new shape either hot or cold;

4. Freedom from crystalline brittleness, so as to resist blows which do not strain it beyond its elastic limit;

5. Freedom from brittleness due to internal stresses produced during cooling or otherwise.

For best usefulness in service it is obvious that these objects must be achieved without great reduction in the strength of the cast iron. In the annealing of steel we customarily secure increased softness and ductility at the expense of some strength. The same result might be noted in cast iron without alarm, provided the extent of reduction in strength was not serious.

### Schaap Heat-Treating Process

Alexander K. Schaap, Brooklyn, N. Y., to secure these objects, carried forward researches in annealing gray cast iron, beginning first with the use of a special flame torch of his own manufacture in the open air, and subsequently using muffles of many different materials, until he succeeded in protecting the iron from deleterious influences and secured the beneficial effect of annealing without producing hard spots in the castings or reducing their tensile strength.

His final process was very simple, and consisted in heating the cast iron to a temperature shortly above the critical temperature (1600 deg. Fahr. = 871 deg. C.) while protecting it in a muffle surrounded by a gas flame and open at the top.

Many different materials were tried for the construction of the muffles, including clay, graphite, cast iron, steel, Armco iron, etc., and all without full success, although steel gave better results than clay. Apparently the permeability of the muffle material to the gases of the furnace, or other influences, had a deleterious effect on the hardness, and other properties, of the annealed iron. The best success was achieved with a muffle made of wrought iron pipe, with a wrought iron bottom welded on it, and an open top. When a crack developed in the side of this muffle, however, hard spots appeared opposite the opening. An electric furnace, in which the cast iron might be heated without coming into contact with products of combustion, gave a satisfactory result on preliminary trials. Further researches are now being made in this type of furnace, with varying compositions of gray cast iron.

As soon as the gray cast iron reaches the proper temperature the muffle and its contents are removed from the furnace and allowed to cool in the open air, the casting being protected from drafts, however, by laying a cover on top of the muffle. In this way it requires only about 15 min. for the iron to cool to a black heat, after which it may be cooled in the open air. The whole operation requires about 45 min., starting with cold cast iron. For thick castings this time needs to be increased only enough to bring the whole mass of metal up to temperature.

The method, as finally developed, has been in continuous use for more than a year, chiefly for the purpose of softening gray iron castings for machining purposes, and especially for making automobile piston rings, upon which Mr. Schaap has an independent patent for mechanical construction.

The result has been a great increase in the softness of the metal; a Brinnell test shows a reduction of 240 to 140 between the untreated and treated specimens (see Table 1), while, with the Shore scleroscope, the corresponding figures are 45 to 35. The loss in strength, as measured both in tensile and transverse tests, is never greater than 10 per cent, and seems to average less than 5 per cent. The metal is of a uniform softness throughout, being free from hard spots, and has proven especially valuable in piston rings because of lack of scoring the cylinders. The annealed rings are also capable of considerable distortion, both hot and cold, as shown by Figs. 1 to 5.

### Characteristics of Schaap Annealed Iron

The most noteworthy characteristic, however, and the one which distinguishes it markedly from gray cast iron and malleable cast iron, is the combination of pliability, ductility, malleability and resiliency. In its resiliency the heat-treated metal most resembles steel, since it shows this property both before and after distortion. For example, a thin bar might be coiled up into a spiral and used as a spring, although, of course, not nearly as strong and resilient as a tempered steel spring. The probable cause of this property will be discussed later.

Three other characteristics are worthy of mention:

1. Preliminary investigations indicate that the gray cast iron, after annealing, does not "grow" by repeated heatings and coolings. It will be remembered that this phenomenon of growth was studied exhaustively by A. E. Outerbridge, Jr. The phenomenon was also observed in industrial work where cast iron was used for superheated steam, for cooling towers in chemical works, and other places where it was subjected to alternations of heating to high temperature and cooling therefrom.

2. The second unique property is the failure of annealed iron to "revert" to the metastable form—that is, to white cast iron—upon heating followed by rapid cooling. The annealed iron, even when melted and rapidly cooled, retains its gray character. (See Fig. 14.)

3. Finally, it is worthy of note that this annealed cast iron does not warp on standing. Such warping action is customarily attributed to the effect of unrelieved internal stresses. Samples of annealed iron have stood for several months without changing shape by as much as one-thousandth of an inch, as compared with unannealed castings of the same metal and pattern, which have warped.

Annealed white cast iron resembles a high-carbon (0.60 per cent) steel in its strength and resiliency, but is much lower in ductility. It may be likened to a high-carbon steel matrix, with inclusions of temper carbon. Indeed, it seems to bear the same relation to high-carbon steel, in its mechanical properties, that malleable cast iron bears to wrought iron. In each case the tensile strength is a little higher, the elongation about one quarter, the malleability correspondingly less in degree, and the resiliency about the same in the slowly cooled condition. The annealed gray and white cast iron both seem to have a low coefficient of friction, thus differing materially from malleable cast iron, whose ferrite matrix makes a tough and frictional bearing.

### Machinability

Many years' experience with annealing, even before uniform results were secured and the final process developed, demonstrated a greater economy in the machining of annealed gray cast iron. This will be evident from the hardness tests in Table 1, and from the fact that all hard spots are removed and the machining qualities are uniform throughout. In order to make a direct test of machining qualities, a comparative test

was made at a large automobile piston factory in New England with pistons cast in their own foundry and the same type of pistons which had been treated by the Schaap process.

Some treated iron pistons, 550 in all, which had previously been rejected because they were either hard throughout or had hard spots which made them unmachinable, were treated against the regular run of the foundry pistons. Six lathes were used, of which

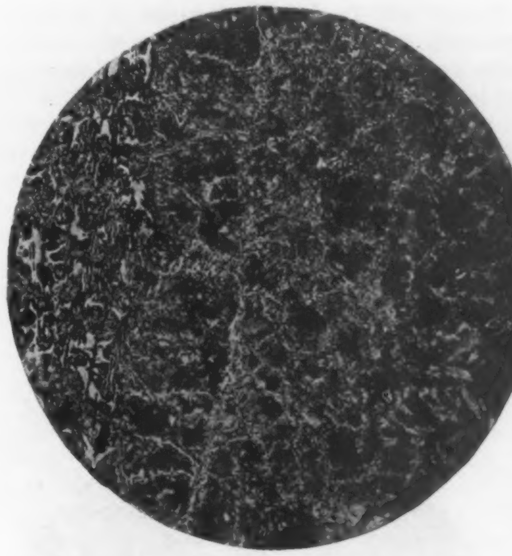


Fig. 6.—Shows the Bond Between the Original Malleable Iron at the Right and the Welding Bar at the Left. It will be noted that the crystals along the line of weld interlock on one side with the recarbonized malleable iron and on the other with the white iron structure of the welding bar filling, giving an intermediate zone of complete coherence between the two materials. Etched, X 100

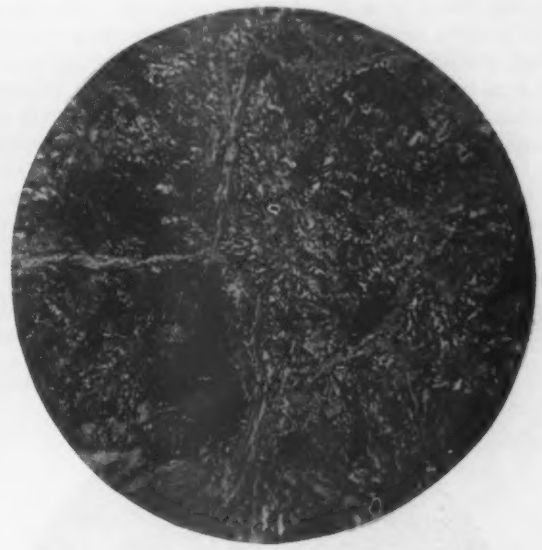


Fig. 7.—Of the Intermediate Zone of Union with the Original Malleable Cast Iron on the Right and the Welding Material on the Left. The matrix is pearlite with envelopes of white cementite resembling a high-carbon steel. It can be seen that the line of union is entirely free from oxide, scale or other imperfections. Etched, X 350

five were used on the regular run of pistons and one on the treated pistons. In this test the same cutting tools were used and the conditions were identical, with the result that on the regular run of castings from two to seven cutting tools were used per 100 pistons turned. The time of turning was 30 sec. per piston. On the heat-treated pistons one tool was used for 168 pistons,

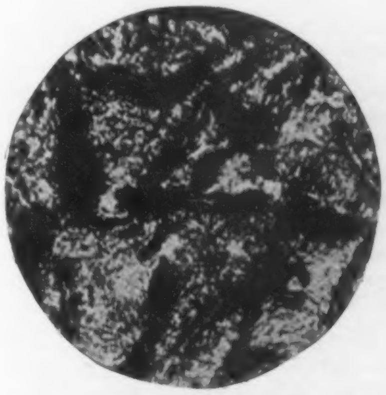


Fig. 8.—Unannealed Gray Cast Iron; Graphite, Pearlite, Cementite and Sulphides. Etched, X 350

Fig. 9.—Gray Cast Iron, Annealed. Carbon, ferrite, pearlite and cementite spicules. All annealings of gray cast iron are 45 min., including heating and cooling. Etched, X 350

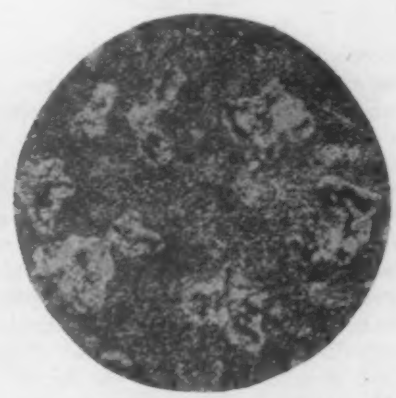


Fig. 10.—Gray Cast Iron Annealed. Carbon surrounded by ferrite in a matrix of pearlite. Etched, X 100

after which it was in good condition and was broken by a piston that was badly out of round. On a second test 100 untreated pistons were run against 100 annealed pistons. Four tools were worn out on the untreated pistons. Only one tool was used for the 100 treated pistons, and it appeared to be in as good condition after the test as at the beginning.

In addition, the maximum variation from the gage of the turned annealed pistons was less than 0.007 of an inch, and the variation was gradual, due to the wearing away of the edge of the tool. The permissible variation from the standard gage was a maximum of 0.015 in., which was passed in from 2 to 15 pistons turned as cast. When the untreated pistons were allowed to stand for a few days they warped slightly out of shape, thereby increasing the variation from the gage. The treated pistons did not change in gage dimensions after standing several days.

Another machining test, while not as extensive as that just described, is confirmatory: An untreated bar was put in a lathe, using a Rex AA high-speed tool, set for a cut ⅛ in. in depth and a speed of 130 r.p.m., with 2⅝-in. travel per min. Under these conditions the cutting tool smoked and this was taken as a pre-

liminary test. An annealed bar of the same iron was then put into the lathe with exactly the same conditions as to cutting tool and depth of cut, but at double speed (namely, 226 r.p.m.), and more than three times the feed (namely, 8¼ in. per min.). The cutting proceeded without any indication of overheating. The r.p.m. was then increased to 390 and the feed to 14½ in. There was still no evidence of overheating; the machined specimen was clean and there was no evidence of wear on the tool. The diameter of the finished work in all cases measured about 0.600 in. The speed of revolution was taken by a speed indicator on the lathe head.

To confirm this result the tool was sharpened and a second attempt was made to machine the untreated cast iron at a higher r.p.m. and travel, but without success. The practicable cutting speed and travel of the annealed iron was then confirmed as 340 r.p.m. with 14½ in. feed. The micrometer showed the same diameter of the turned part at the beginning and end of the cut and no tool damage. It was deemed practicable to machine this cast iron commercially under these conditions.

Several other tests have been made to bring to machinable condition iron castings which were commercially unmachinable on account of hard spots or hardness throughout. A number of such instances might be cited, but the most exhaustive is the case of a large plant in New England which sent down a goodly number of castings of unmachinable character. Some of these castings were broken in two, one part being retained without treatment as a comparison. All the remainder were annealed and returned to the factory, including one-half of each of the broken castings, which were easily identified by the fracture, and all proved to be machinable without the slightest difficulty. The experiment has also been tried of taking a white iron sash weight, mottled in the center, annealing it, and then machining it at a high speed and deep cut.

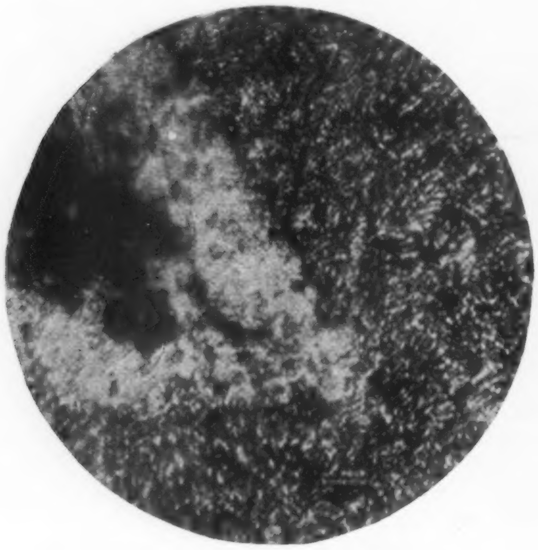


Fig. 11.—Gray Cast Iron, Annealed. Temper carbon nodule surrounded by ferrite, in a matrix of pearlite. Etched, X 1000

Fig. 12.—Gray Cast Iron, Annealed. Carbon nodules surrounded by ferrite. Etched, X 1000

### Welding Rods for Malleable Cast Iron

Welding malleable cast iron and gray cast iron with the oxyacetylene torch, or with the electric arc, is wholly practicable if certain conditions are met. The electric welding is especially easy, using a steel rod as one electrode, but the equipment for electric welding is not common and the high temperature of the melted steel burns the iron. With oxyacetylene welding of malleable cast iron, a gray cast iron welding rod gives a weak joint, while steel and wrought iron rods burn the malleable cast iron by overheating. A malleable cast iron welding rod, after melting into the joint and cooling quickly against the metal, reverts to a brittle white metal. Welding rods of which iron annealed by the Schaap process melt at a low enough temperature to avoid burning the iron, make a perfect union between the two parts, and constitute a tough and soft joint. This joint can be dressed and finished so that there is no evidence of a weld, and the strength is equal to that of the malleable cast iron.

Figs. 6 and 7 show micrographs of welding joints made with the oxyacetylene flame in this way. Fig. 7 shows a matrix resembling steel. When using malleable cast iron rods for welding it is noted that the center of the rod melts out, leaving the decarbonized outer surface as an unfused shell which extends a fraction of an inch from the hollow center. The Schaap annealed white iron rods do not show this difference in fusibility between center and outside. Even after melting and cast against an iron plate the metal is malleable, ductile and soft. The fused end of a rod rapidly cooled against iron was hammered out and tested with a file and by bending.

### Varieties of Iron Treated

Pressure of industrial work has not permitted time for a research on annealing cast iron of several different analyses. But, although only a few samples have been analyzed, the products of many different foundries have been treated with like results. In Table 1 we have included analyses of gray cast iron and of white cast iron, whose treatment will be discussed later.

### Annealing Process for White Cast Iron

In Table II are shown some tensile tests of white cast iron annealed in different ways, in an attempt to determine which was the best method. All the specimens from 1 to 7, inclusive, were of the same metal. Specimen 5 was analyzed and the results given under D, Table I. The heat treatment of these specimens was as follows:

1. Hard white cast iron, untreated.
2. Same iron maintained for ½ hr. at 1600 deg. Fahr. and cooled in a muffle outside the furnace, as described.
3. Same metal maintained 1½ hr. at 1600 deg. Fahr. and cooled in the same way.
4. Same iron heated for ½ hr. at 1600 deg. Fahr.

and cooled in the same way. This treatment then repeated nine times.

5. Same iron maintained for 3 hr. at 1600 deg. Fahr. and cooled as described.

6. Same iron maintained 3 hr. at 1600 deg. Fahr. and cooled in furnace.

7. Same iron maintained 3 hr. at 1900 deg. Fahr. and cooled in furnace.

From these tests it is evident that the best treatment is to heat the iron to a temperature not exceeding 1600 deg. Fahr., maintain at a temperature for at least three hours and then cool in the muffle outside of the furnace as described above. Heating to higher temperatures, as might be expected, has a bad effect on the strength and ductility of the metal. Later experiments in heating white iron for six hours at temperatures not exceeding 1600 deg. Fahr. have given excellent results.

A test was also made of a treated white cast iron bar in comparison with a malleable cast iron bar made from the same iron. Each bar was subjected to an alternate bending fatigue test on an Upton Lewis fatigue testing machine with the following results:

| | Treated Iron | Malleable Iron |
|---|---|---|
| Size of bar | 1 x ⅜ x 6 in. | 1 x ⅜ x 6 in. |
| Dimension of section | 0.999 x 0.353 in. | 1.009 x 0.350 in. |
| Stress on extreme fiber, lb. per sq. in. | 30,000 | 30,000 |
| Fatigue elastic limit, alternations | 61,000 | 21,600 |
| Alternations to break | 64,500 | 22,200 |

Fig. 13.—Annealed White Iron Welding Rod; This Is the Unfused End. Etched, X 100

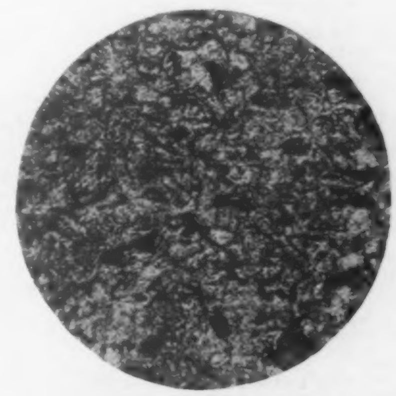


Fig. 14.—End of Rod Illustrated in Fig. 13, Which Has Been Fused and Cooled against an Iron Plate. Etched, X 100

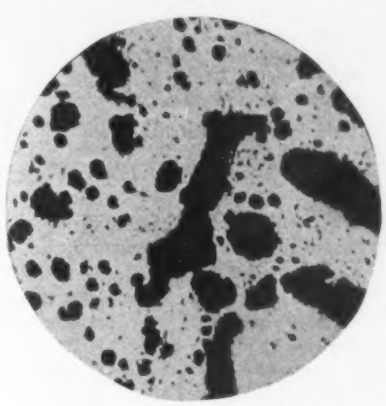


Fig. 15.—White Cast Iron. Annealed too short a time for complete resolution of graphite flakes. Unetched, X 110

Fig. 16.—Analysis G in Table 1. White cast iron, annealed 6 hr. Temper carbon, cementite and pearlite. Etched, X 300

### Mechanical Tests

In Table II are given some tensile tests and hardness tests of gray cast iron and white cast iron. In Table III are transverse tests of gray cast iron. This latter test proves conclusively that the strength of the iron can be maintained only if the temperature of the treatment is within 100 deg. Fahr. above the magnetic change point of the iron, and if the cooling to black heat takes place within a space of 15 min. The samples in Table III, heated to too high a temperature, or cooled too slowly, have decreased in tensile strength more than is necessary by the treatment. Indeed, it is believed that, under proper conditions of heat treatment, the strength of the iron will be as great, or greater, than that of the untreated metal.

A treated white iron bar was tested for rigidity and the following results reported:

| | |
|---|---|
| Dimensions | 0.790 x 0.923 in. |
| Span | 12 in. |
| Maximum load | 3,890 |
| Extreme fiber | 103,750 lb. per sq. in. |
| Deflection | 0.67 in. |
| Angle of bend | 8 deg. |

Confirmatory of the general results of this test was an alternating-stress fatigue test on a bar of treated white cast iron vs. a like bar of malleable cast iron, both turned to a diameter of ½ in. for a space of 2 in. long and rotated slightly out of alinement. The treated white cast iron bar failed after 278,100 revolutions; the malleable cast iron bar after 136,900 revolutions.

### Microstructure

Some typical micrographs of the metal are shown in Figs. 8 to 16, inclusive, which dispel a good deal of the astonishment aroused by the foregoing report of mechanical properties, malleability, etc. Figs. 8 and 9 show how the heat treatment has changed the original structure: This consisted, as cast (Fig. 8), of coarse grains of graphite, leaving only short and separated metallic paths of rupture. The treatment produces an almost continuous metallic phase, with relatively small particles of carbon between. The metallic phase will readily endure distortion without fracture, which the almost continuous graphite phase lacks sufficient pliability to do. Fig. 10 shows more clearly the action

which apparently has occurred: At a temperature of 1600 deg. Fahr. the coarse flakes of graphite have apparently been absorbed to some extent in the solid solution existing at that temperature; with the moderately slow cooling which follows, the solid solution breaks up into ferrite and pearlite, mixed with fine particles of carbon surrounded by crystals of ferrite from which it has separated. This action is shown still better by Figs. 11 and 12, in which is brought out the character of the pearlite matrix, which seems to be semi-globular in structure rather than the lamellar pearlite of annealed white cast iron (shown in Fig. 16).

*Table I—Chemical Analyses and Hardness Tests*

| Gray Iron | Carbon C.C. % | Carbon G.C. % | Si % | S % | P % | Mn % | Hardness Bri-nell | Hardness Sclero-scope |
|---|---|---|---|---|---|---|---|---|
| A-1. Gray cast iron—Untreated | 0.66 | 2.73 | 2.36 | 0.064 | 0.736 | 0.37 | 240 | 45 |
| A-2. Gray cast iron—Annealed | 0.11* | 3.19 | 2.50 | 0.086 | 0.746 | 0.29 | 140 | 35 |
| B-1. Gray cast iron—Untreated | 3.28 | 2.93 | .... | ..... | ..... | .... | 245 | ...... |
| B-2. Gray cast iron—Annealed | 0.09* | 0.58 | .... | ..... | ..... | .... | 135 | ...... |
| C- Gray cast iron—Annealed | 0.10* | 3.20 | 2.97 | 0.075 | 0.709 | 0.53 | .... | ...... |
| White Iron | | | | | | | | |
| D-1. White cast iron—Untreated | ..... | ..... | .... | ..... | ..... | .... | 418 | ...... |
| D-5. White cast iron—Annealed | 0.76 | 1.17 | 1.18 | 0.069 | 0.176 | 0.26 | 255 | ...... |
| E- White cast iron—Annealed | 0.64 | 1.63 | 1.01 | 0.074 | 0.169 | 0.34 | 217 | 35 to 38 |
| F- White cast iron—Annealed | 0.83 | 1.25 | 1.04 | 0.061 | 0.168 | 0.27 | .... | ...... |
| G- White cast iron—Annealed | 0.81 | 1.68 | .... | ..... | ..... | .... | .... | ...... |
| H- Welding bar — Annealed w.c.i. | 0.45 | 1.68 | .... | ..... | ..... | .... | .... | ...... |

*In recent treatments, the combined carbon is intentionally left at a higher point than this, in order to obtain a pearlitic matrix.

One is surprised to observe that so short a treatment suffices to produce this result, but a large number of photomicrographs seems to leave no room for doubt. In this connection it should be noted that the amount of combined carbon shown by these micrographs is greater than that given in the analyses in Table I. This represents more recent treatment, and especially cooling in the open air from immediately below the critical temperature.

The structure of the iron indicates clearly the difference between this metal and malleable cast iron made by the usual annealing process of 6½ days: The latter consists of a ferrite matrix with particles of temper carbon;[7] the purpose of the annealing is to completely decompose the cementite of pearlite into carbon and ferrite. This doubtless explains the necessity for the long time of annealing for malleable cast iron, and also the lack of resiliency, which could not be expected in an almost continuous ferrite phase. On the other hand, the resiliency of this annealed iron, which so resembles that of steel, is apparently due to the pearlitic, instead of the ferritic, phase. Mr. Schaap has apparently preserved some of the qualities now sought in so-called "pearlitic cast iron,"[8] while, at the same time, ridding the iron of some of its hardness, brittleness and non-malleability.

Another difference between this metal and malleable cast iron is the absence from the former of decarbonization, so familiar to all in the white rim of "black heart" malleable cast iron. The microscope does not reveal any more surface decarbonization than is present in rolled or annealed steel, for example, an insignificant "epidermis" of metal slightly lower in carbon than the center, due to surface oxidation. Right here it should be explained that the annealed iron discussed in this monograph is of a very different character, and suitable to a different field, from that of ordinary malleable cast iron. Its cost of production is materially lower, its ductility is lower, and its strength may be very much higher than that of malleable cast iron.

In the annealing of white cast iron, as indicated in Figs. 15 and 16, a much longer time for annealing is required than in the annealing of gray cast iron, in order that the carbon may be resolved into small particles; that pro-eutectoid cementite may be decomposed, and an almost continuous pearlitic phase established. The structure of the iron, as illustrated in Fig. 16, readily explains the strength and slight ductility indicated in specimens D5 and E in Table II.

**Rationale of the Treatment**

Astonishment has been expressed at various times, by metallurgists and others, that so simple a process should effect such a profound change in cast iron. It is probable, however, that this astonishment springs more from the unexpectedness of the results after what has been taught for so many years regarding the annealing of cast iron, than from logical reasoning. It has been taught and believed that heating above the magnetic change point ruined the strength of gray cast iron, and that the annealing time of white cast iron could not be decreased with advantage. Therefore, most investigators have confined their researches to these two points; it has not occurred to them to study the other properties of the annealed metal. Or, if they did study them, no commercial use was found for annealed white cast iron of 90,000 lb. per sq. in. tensile strength and only 3 per cent elongation; nor for a pliable, malleable and resilient cast iron whose strength had been reduced to only a few thousand pounds.

*Table II—Tensile Tests of Untreated and Treated Irons*

| Chemical Analysis Table I | Cast Iron | Treatment | Ultimate Strength Lb. per sq. in. | Elongation Per Cent in 2 in. | Red. of Area Per Cent | Hardness Bri-nell | Hardness Sclero-scope |
|---|---|---|---|---|---|---|---|
| A1 | Gray | Untreated | 21,750 | ... | ... | 228 | ..... |
| A2 | Gray | Annealed | 20,070 | ... | ... | 163 | ..... |
| | Gray | Quenched (Note 1) | 23,690 | ... | ... | 300 | ..... |
| D1 | White | 1 Untreated | 52,220 | ... | ... | 418 | ..... |
| D2 | White | 2 (Note 2) | 61,750 | ... | ... | 387 | ..... |
| D3 | White | 3 (Note 3) | 69,220 | ... | ... | 402 | ..... |
| D4 | White | 4 (Note 4) | 82,580 | ... | ... | ... | ..... |
| D5 | White | 5 (Note 5) | 88,500 | 3.5 | ... | 255 | ..... |
| D6 | White | 6 (Note 6) | 98,880 | 1.0 | ... | ... | ..... |
| D7 | White | 7 (Note 7) | 54,640 | 0 | ... | ... | ..... |
| E | White | Annealed | 86,090 | 3.0 | 2.4 | 217 | 35-38 |

Notes: 1. Heated to 1600 deg. Fahr. and then quenched in water.
2. Held for ½ hour at 1600 deg. Fahr., and then cooled as described above.
3. Held for 1½ hr. at 1600 deg. Fahr., and then cooled as described above.
4. Heated 10 times to 1600 deg. Fahr., held there for ½ hr. each time, and then cooled as described, between heatings.
5. Held for 3 hr. at 1600 deg. Fahr., and then cooled as described above.
6. Held for 3 hr. at 1600 deg. Fahr., and then cooled more slowly.
7. Held for 3 hr. at 1900 deg. Fahr., and then cooled in air.

Alexander K. Schaap found a way to soften cast iron without exposing it to the influences which had caused such ruinous results in the experiments of previous investigators. After this had been accomplished, the next step was to develop a process for making this knowledge of commercial value. The reason why the iron was softened can be readily understood from the facts, figures and photomicrographs given in the foregoing pages.

It only remains to ask: What deleterious substances, or influences, were avoided by Schaap which had ruined the strength of the cast iron of other investigators? We know that muffles of clay, graphite and cast iron

[7] H. A. Schwartz, "American Malleable Cast Iron," Cleveland, Ohio, 1922, p. 68.

[8] "Pearlitic Cast Iron: Its Production, Mechanical Properties and Possibilities," *Foundry Trade Journal* (June 7, 1923), vol. 27, pp. 454-6. Also THE IRON AGE, Aug. 16, 1923.

gave poor results; that steel muffles and electric furnaces in which there are no products of combustion were better; but that wrought iron muffles with closed bottom and open top seemed to give the best practical protection as long as there were no cracks in the sides. We know that gases—for example, hydrogen—will

*Table III.—Transverse Tests of Untreated and Treated Irons*

Bars, 14 in. long x 1 in. square; span 12 in.

| Treatment | Load, Lb. | Deflection, In. | Hardness, Brinell | Chemical Analysis |
|---|---|---|---|---|
| Untreated | 2,900 | 0.16 | 228 | A1, Table I |
| Annealed | 2,530 | 0.16 | 163 | A2, Table I |
| Annealed | 2,990 | 0.16 | 163 | A2, Table I |
| Annealed | 2,800 | 0.18 | ... | A2, Table I |
| Untreated | 4,450 | 0.14 | 196 | |
| (Note A) | 3,570 | 0.12 | 140 | |
| (Note A) | 3,810 | 0.16 | ... | |
| (Note A) | 3,920 | 0.12 | ... | |
| (Note A) | 3,610 | 0.10 | ... | |

Note A: These bars were soaked in the furnace at 1500 deg. Fahr. for ½ hr. and then cooled too slowly by remaining in the furnace.

permeate clay, graphite, cast iron, and even steel, at a red heat. We know that hydrogen has a deleterious effect on the properties of iron and steel, and that it is present in products of combustion. It has been assumed that the Schaap process protects the cast iron above the critical temperature from hydrogen and its compounds, and possibly from other harmful gases and influences.

This it may do in two ways: 1. With the open-top muffle the heavier products of combustion, such as CO, $CO_2$, will flow over the sides and replace lighter gases in the atmosphere in which the cast iron is being annealed. 2. The wrought iron muffle walls serve as a better protection against the penetration of hydrogen (for example), than do clay, steel, etc.

In an attempt to throw light on this question, gases were drawn from the inside of the muffle at the bottom by means of a ½-in. pipe welded in at that point. The results give some information on the flowing of heavy gases into the top of the muffle but, unfortunately, not on the other part of the question, because, through a misunderstanding, no attempt was made to analyze the gases except for $CO_2$, CO and O. The results follow: The furnace was started at 2.45 p. m. The following are the results of gas analyses at corresponding time and temperature:

| Time | Temperature, Deg. Fahr. | Per Cent of Volume: $CO_2$ | $O_2$ | CO | $N_2$ (by dif.) |
|---|---|---|---|---|---|
| 2:55 p. m. | 800 to 900 | 14.0 | 5.6 | 0.9 | 79.5 |
| 3:15 p. m. | 1,200 | 10.64 | 1.05 | 9.05 | 79.26 |
| 3:30 p. m. | 1,425 | 20.62 | 0.63 | 2.32 | 76.43 |
| 3:40 p. m. | 1,580 | 23.55 | 0.22 | 2.53 | 73.70 |

These readings were taken consecutively as the furnace and contents were coming up to heat.

# 53 YEARS OF PIG IRON IMPORTS

## High Record of 1922-23 Considerably Lower Than at Times in the Past

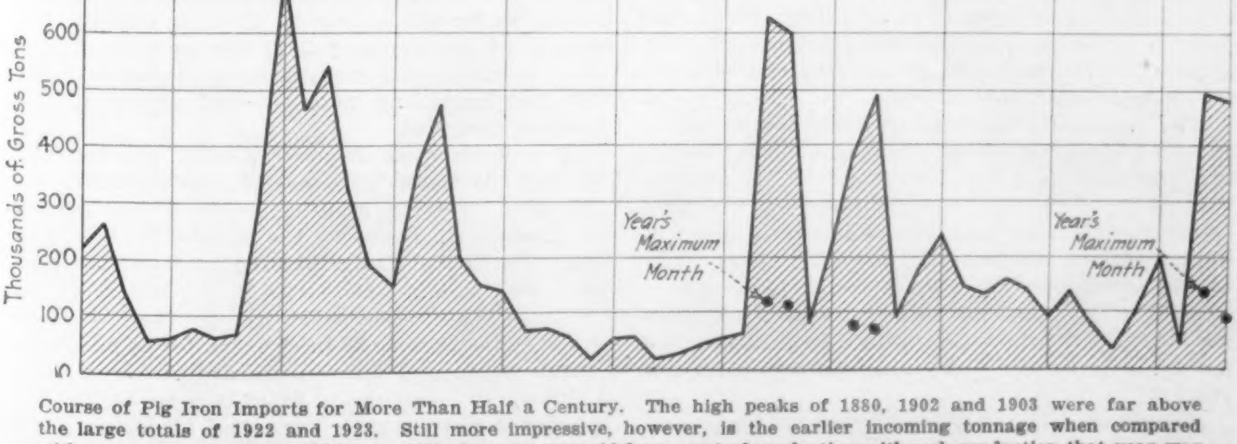
While the high tide of pig iron imports last year, due to the coal strike and consequent inability of American producers to get all the coke they needed, pushed the maximum month's incoming shipments to about 110,000 tons, the record of the past half century shows several cases where the yearly imports of pig iron were greater than in the recent period. The highest of all, based on the calendar years' figures, was in 1880, when we imported 700,864 tons of pig iron and ferroalloys.*

For several years both sides of that date—five years altogether—the imports exceeded 300,000 tons in each year. This may be compared with 492,843 tons in 1922 and with a total which may reach 480,000 tons when the returns for 1923 are all in. The figures for 1922 and 1923 were exceeded not only in 1880, but also in 1882, with 540,159 tons; in 1902, with 625,383 tons; in 1903, with 599,574 tons; and very closely approached in 1906, with 489,475 tons; in 1887, with 467,522 tons, and in 1881, with 465,031 tons.

If it be pointed out that the heavy movement of 1922-23 came at the turn of the year, thus producing a total in the fiscal year ended June 30 last of 787,410 tons, it is equally true that the incoming tonnage in the fiscal year ended June 30, 1903, was 962,227 tons, or 22 per cent higher than in the more recent period.

As a matter of fact, the highest "monthly" figure in 1922-23 at 132,573 tons is the figure for a total of 40 days—from the time the new tariff law went into effect, Sept. 22, 1922, until Oct. 31, inclusive. Careful estimates place the imports in the 31 days of October alone at 110,700 tons. Compared with this may be cited the following figures of 20 years ago: November, 1902, 100-400 tons; December, 118,373 tons; January, 1903, 110,-679 tons. During the fiscal year ended June 30, 1903, only one month fell below 57,000 tons, that being February, with 45,187 tons; while the fiscal year 1922-23 had only six months over 57,000 tons.

*Ferroalloys are included in all figures herein, because in the earlier years there was no separation.




Course of Pig Iron Imports for More Than Half a Century. The high peaks of 1880, 1902 and 1903 were far above the large totals of 1922 and 1923. Still more impressive, however, is the earlier incoming tonnage when compared with our own production. Thus, in 1880, imports were 18.3 per cent of production, although production that year was 50 per cent above the highest previous record. Imports in 1887 were 7.3 per cent of the record production of that year; in 1922, only 1.8 per cent and in 1923 about 1.2 per cent

# Development of Power Presses and Dies

## Automotive Requirements Large Factor in Advancement—Contribution of Designers to Economical Manufacture—Intricate Stampings and Equipment Developed to Produce Them

BY HENRY J. HINDE*

THE working of sheet metals dates back to the earliest centuries. Push-through dies for the production of tubular shells of brass and copper were made use of as long ago as the seventeenth century. The principle of the draw ring, the greatest step ever made in the stamping industry, was developed in Europe somewhere near the year 1800. The draw ring was then operated by means of weights and levers.

The art of producing metal stampings from flat sheets while cold has made marked progress in recent years. A few years ago the operations of blanking, flanging, shearing and forming were very simple. But the requirements of sheet metal workers have caused many minds to turn their attention to the development

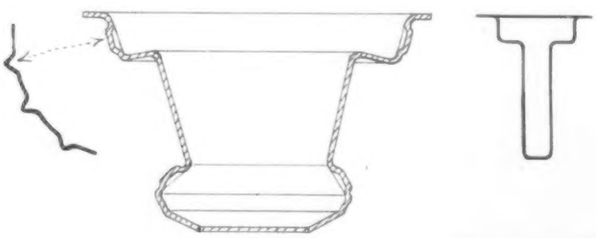


Fig. 1

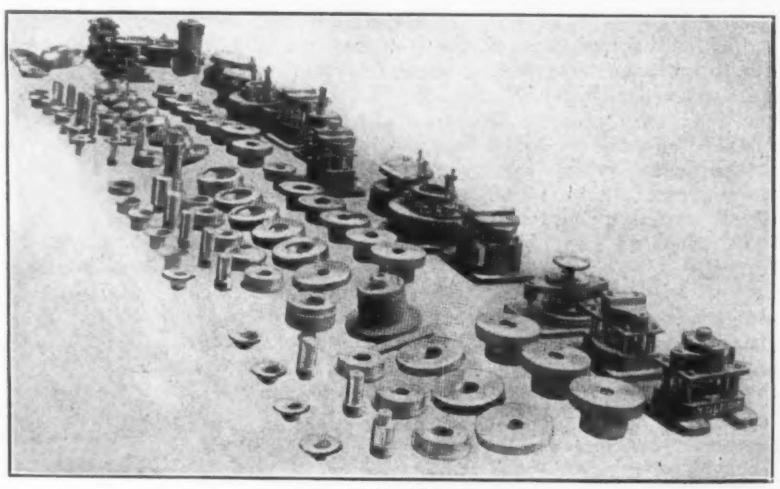


Fig. 2

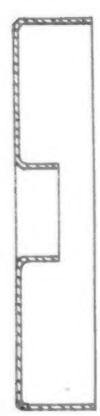


Fig. 3

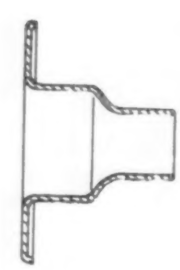


Fig. 4

of the original and primitive methods used in such work to the special needs of various lines of manufacture. A great many articles are now made of sheet metal which formerly were produced by casting, forging or machining.

The demand for lower priced goods and the necessity for greater uniformity of product and interchangeability of parts have had much to do with the development of the presses and dies. Forming and stamping operations especially have become in many classes of work very complex, and the art of drawing sheet metals, stimulated in a large degree by the enormous demand of the automobile industry in particular, calling for some of the most intricate shapes, has reached a state of perfection hardly imagined possible a few years ago.

The results achieved by the ingenuity of the present day press and die designers, and to a smaller degree by the metallurgist who comes into consideration through his improvements of the physical qualities of the metal used, are indeed revelations in economy of production, strength and interchangeability of stamped articles and beauty of appearance of the finished article.

### Machines Unusual Years Ago Commonplace Today

Machines and tools which forty years ago would have been considered quite large and novel would today excite but passing notice, if any. About twenty-five years ago a single-crank, straight-column power press, having a shaft 13 in. in diameter and a pressure capacity of approximately 1000 tons, was built for a new company, which, in addition to other stamped and pressed steel products, was just starting in to produce stampings for automobile parts. This press was then considered so large that designers of other press building companies were invited by the purchaser to see the machine. The builders themselves at that time were of the opinion that there would be so little demand for machines of so large a size that the expense incurred in designing patterns and equipment was not warranted. The same press builders are today furnishing the same type of press in considerable numbers, having crankshafts as large as 20 in. in diameter and capacity of approximately 2000 tons pressure at peak load. Instances have recently occurred demonstrating that still larger and more powerful presses of this type are demanded.

This development of power presses, together with the dies and special tools, has been so marked in the last several years, principally because of the demand for intricate stampings for the automobile trade, that it is believed that far greater advancement has been made than at any other period in the history of the business. This development has not been confined wholly to the working of sheet metal, for as previously stated, the demand for accurate duplication of parts and the great quantities in which they are desired has resulted in power presses being used for sizing forged steel parts, which were formerly finished by means of straddle milling and similar operations. It has been found that larger quantities can be produced with much

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greater accuracy and with a reduction in cost by the use of what is known as knuckle joint or cold swaging presses in sizing the finished working surface of these forgings, and a number of equipments have been installed for work of this kind. It is claimed that size limits of 0.001 in. can be maintained in these operations.

### Press and Die Designers Aid Auto Production

Although to the automobile industry more than to any one factor in recent years is due this marked advancement, at the same time the economical production of motor cars was made possible solely on account of the ability of the press and die builder to successfully control the flow of the cold sheet metal into certain forms and shapes, by the means of properly constructed dies and presses. Remarkable results have been obtained, the wire wheel hub illustrated in Fig. 1 being an example.

The hub requires a blank 16½ in. in diameter and 5/32 in. thick. Particular attention is called to the numerous niches or pockets formed into the circular shape and also how the stamping was first drawn to a considerable depth at the narrow neck. The end of the neck, or bottom of the stamping, was then removed and this metal was made to flow back and expand to a considerable degree beyond its former small diameter

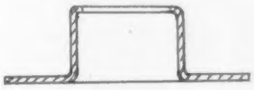

Fig. 5

Fig. 6

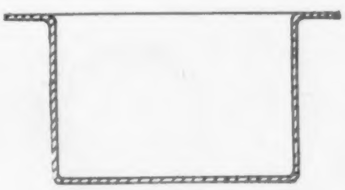

Fig. 8

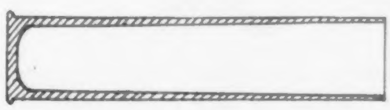

Fig. 9

in the reforming operations. This demonstrates how successfully the metal was controlled and forced to flow back into its larger diameter with an opening in the bottom much smaller than the former small diameter of the neck of the stamping. One of the requirements of the stamping to be produced was that it should have no constructive weakness, because of the tendency of the metal to stretch thinner than its original thickness, which so often results when the tools are improperly constructed for press and die operations of this nature.

### Production of Brake Drums and Other Parts

The stampings and the four groups of dies for producing them shown in Fig. 2 are similar examples. The first set of dies at the top of the illustration is for producing the brake drum shown in Fig. 3, which is 12 in. in diameter and 2¾ in. deep and from a 3/16 in. steel blank, a hole with a flange formed all around being in the center. The hole in the center presented the greatest difficulty, the flange being of considerable height. When forming a flange around a hole the metal is materially reduced in thickness, and in this instance had to be restored by upsetting to near double the thickness of the flange. Aside from the blank cutting and perforating it required five operations to give the drum the desired shape.

The second set of dies is for stamping the front hub shown in Fig. 4, which has flanges formed of a somewhat mushroom shape. The finished hubs are 5⅝ in. deep, the smallest inside diameter 2⅜ in. and the flange diameter 7 in. The hubs are formed in steel plate ¼ in. thick. Plain hubs are first formed larger than the finished flange and are greatly reduced in diameter, the depth increased and the flange formed by degrees. Exclusive of the blank cutting and other similar operations, it required eight successive drawing, redrawing and stamping operations to finish the hub.

The third and fourth sets of dies, respectively, produce the stampings for the rear hub and the spoke

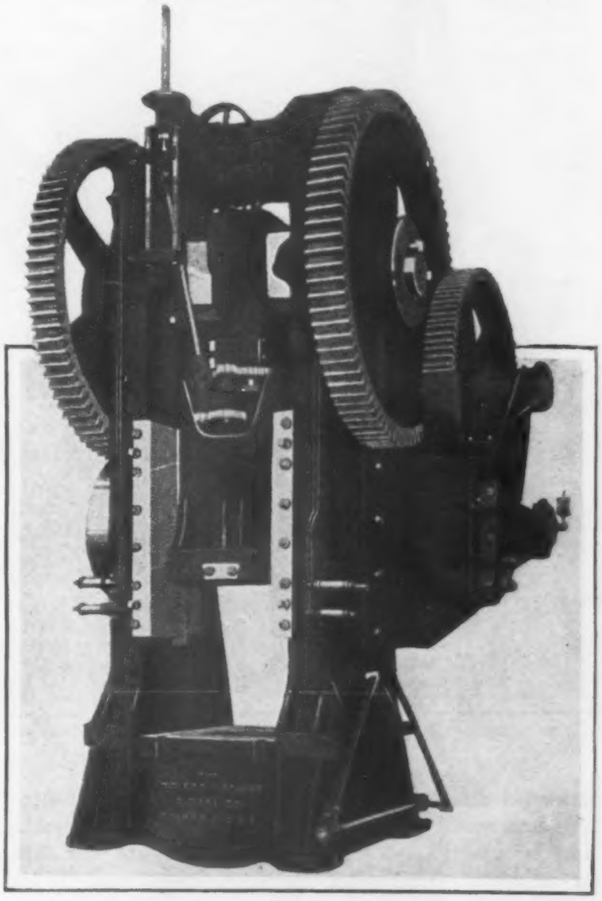

Fig. 7

flange. The rear hub, shown in Fig. 5, requires six and the spoke flange, shown in Fig. 6, four drawing, redrawing and stamping operations. Both are made of ¼ in. steel plate.

The products of the several dies are placed in front of each in Fig. 2, which shows the appearance of the stampings through the successive stages of manufacture. The outline drawings, Figs. 3, 4, 5 and 6, show the finished article.

The conditions that had to be filled by these dies were that the product was to be interchangeable; that no machine work was to be performed upon the stampings when coming from the press, excepting certain reaming and thread cutting; and that the strength of the material had to remain unimpaired. In addition, it was imperative that all of the cylindrical parts be smooth and true and of standard diameter, allowing less than the commercial tolerance of variation. It is a rather difficult matter, particularly in the case of the stamping of the small cylindrical body having a large flange, as represented by the front and rear hub flanges and to some degree by the spoke flange, to cope with such conditions. The work involved a most

careful planning of the inter-relation of the several operations so that at no time the material should be overstrained or reduced in thickness, and that the dies should not be subjected to excessive wear in order to maintain uniformity of size.

### Presses Designed As Carefully As Dies

For cold forming or shaping work such as just described, powerful presses are required that must be as carefully designed as the dies which are operated in them. A press suitable for operating the dies described above is shown in Fig. 7. This is a straight-column cutting and forming press of rugged proportions its weight being about 145,000 lb. net. It is double geared with a ratio of 40 to 1 and is fitted with a powerful friction clutch in combination with an effective brake and hand lever control, so that the machine may be started or stopped at any point of the slide, up or down. The frame is of four-piece steel tie rod construction, the four pieces being the bed, the two uprights and the crown. They are held together by four massive tie rods passing through the crown, uprights and bed and when the frame is assembled these tie rods are heated. The nuts are then screwed home and the rods permitted to cool. Through the tendency of the rods to shrink, an enormous pressure is exerted by the rods upon the frame that renders the structure practically an integral one, and brings all the working load upon the tie rods. The shafts and also the tie rods and adjusting screw are hammer forged from special analysis steel of not less than 0.45 per cent carbon, and the crankshaft and connection screw are carefully oil treated to obtain the maximum elastic limit. Bearing surfaces are of liberal proportions and an unusual length has been given to the ways of the slide and the slide proper.

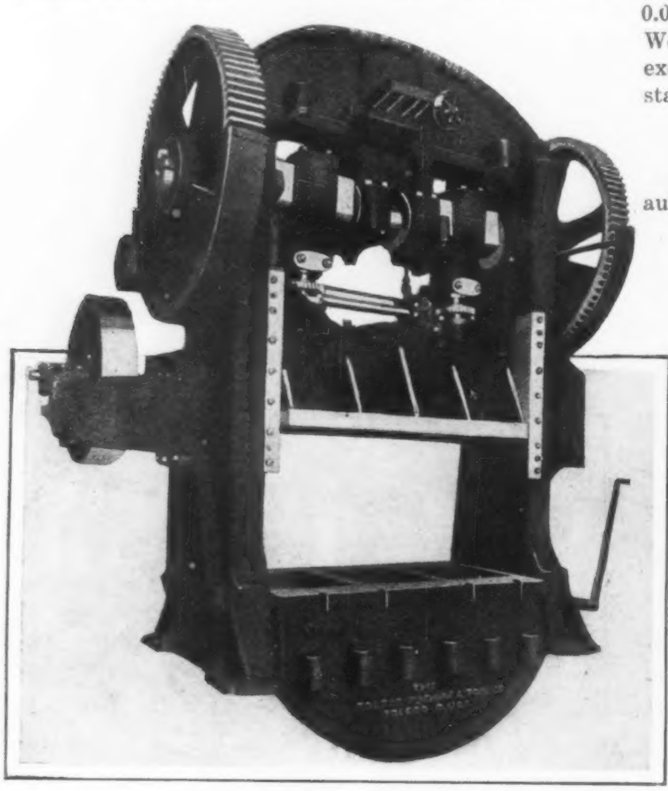

Fig. 10

Another illustration of unique results in forcing metal to flow cold is the clutch casing shown in Fig. 8. This is made from a blank 18 in. in diameter and 5/16 in. thick. The finished casing has a flange 12 in. in diameter with a shell 9¼ in. in diameter and 5¾ in. deep. The drawing operation and the finish sizing operation brought the stamping to a remarkably true and uniform shape and thickness, with the particularly sharp corners required. The stamping was produced in four operations on a single-crank toggle drawing and deep stamping press, but dies for small shells are frequently operated in a straight-column, single-action press, like that shown in Fig. 7, only smaller.

The cartridge case shown in Fig. 9, as well as other similar cases made during the late war, is another instance of remarkable results in forcing metal to flow cold. The case illustrated measured about 3 in. in diameter and 14 in. in. length, over all, when finished. This stamping was produced from a plain flat blank 5⅝ in. in diameter by ⅜ in. thick. It may be noted that there is an accumulation of metal at the solid or bottom end of the case. Here again accuracy was required, the limits of variation being held to between 0.0015 in. outside and 0.0015 in. inside measurements. Working pressure of something over 1200 tons was exerted in the finished sizing of the end of this shell stamping.

### Double Crank Press for Larger Stampings

The nature and size of many stampings for use in automobiles and in similar work is such that it is hardly practicable to operate the dies in single crank presses, owing to the large bed area required. For this work a double crank press of the type shown in Fig. 10 is frequently employed, such presses being available in many widths and sizes to take care of practically any requirements. The machine illustrated weighs approximately 250,000 lb.

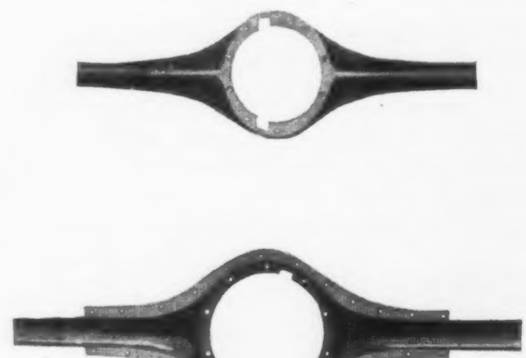

Fig. 11

Axle housings similar to those shown in Fig. 11 are most often made in presses of this type. Axle housings are made of steel plate up to 5/32 in. in thickness. The stampings are required to be perfectly straight and flat so that when the two halves of the axle housing are joined together by welding, they form a perfect casing without warp. A press of sufficient capacity to operate the dies for these parts would weigh about 95,000 lb. The distance between the uprights should be about 60 in., and it should be capable of forming cold at one blow or stroke the axle housing halves, after the blank had been previously cut to shape.

The dies and presses thus far described are typical for the shaping or forming of heavy metal parts cold, and are illustrative of a wide range of cold forming work that may be formed in machines of this character.

### Features of Press Design for Present Day Work

It is appropriate to say a few words in regard to the design of the presses. A few years ago practically all presses were of the solid one-piece frame construc-

tion and of small size. The work of today requires presses of greater power and better construction. The press of today has passed through a period of design similar to that of the automobile.

The modern press frame, as stated, is made up of four pieces, which are held together by tie rods that have been heated in place and the nuts drawn or screwed down. These rods when cool hold the frame together and take all the load, due to the pressure upon the slide and bed. Overhanging gears and pinions have been eliminated, as well as outboard bearings and stands. Double geared presses have chain oiling bearings on the driving shafts. The additional speeds required of the present press have resulted in improvements in the design of clutches, flywheels, gears and all other parts. Large connection screws are now made with a special buttress thread, which reduces the

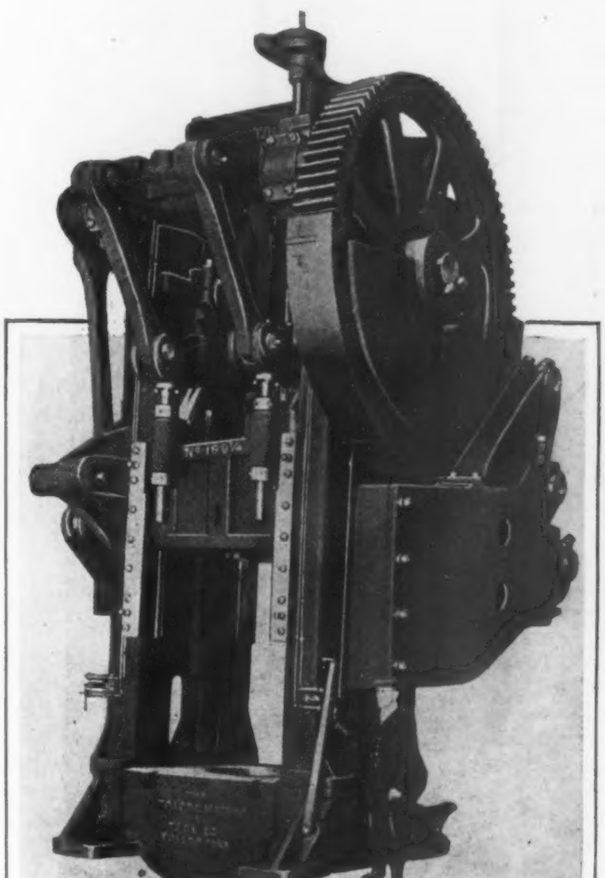

Fig. 14

tendency to split the connection. The medium and larger presses are now arranged with power slide elevating attachment to facilitate the adjustment of the slide. This feature alone has done much to reduce the idle time of changing dies and operations.

Automatic and semi-automatic feeds of different kinds have been developed to facilitate production, and among these might be mentioned roll feeds, dial feeds, hopper feeds, slide feeds, or possibly a combination of one or more of these types. Other attachments, such as knockouts, spring pressure attachments, strippers, cam strippers and hold-downs, while not new, have been highly developed in the last few years.

Presses are now used for many things in addition to the ordinary working of sheet metal, such as broaching and sizing bushings, transmission gears and other articles. Other machines have also been developed, such as edgers, double seaming machines, gang slitting machines, circle cutting and square shears, beaders, trimming machines, expanders and wire ring machines. Machines are also made for forging the eyes in axes and picks, as well as pieces of similar nature.

**Stampings Made on Double-Action Presses**

At this point consideration should be given to the special or double-action drawing presses and the types of stampings made in them. What is believed to be the first and largest equipment of double-action presses for steel stampings installed in this country was that required for the production of the semi-steel bath tub shown in Fig. 12.

At the time it was thought necessary to heat the stamping because of the thickness of the metal and the large size of the blank required to produce the forms and shapes. This is mentioned to show what a great development has taken place in the art, which has largely eliminated costly heating operations, stampings of almost any size and thickness and of considerably more intricate shapes than the bath tub being now regularly produced without heating the sheets.

In developing the equipment for producing this bath tub a set of preliminary tools for a one-quarter size model was made to determine the action of the metal and the power required. The tools for the small model were completed and the stampings successfully produced. The dies were then made for the large tub, which was about 5⅛ ft. long, of 3/16-in. steel. Before the equipment was finally completed it was discovered

Fig. 12

Fig. 13

that the large finished stamping required sixteen times the amount of power that was necessary for producing the small one-quarter size model.

About 18 years ago a progressive stamping company in the middle West recognized the fact that the automobile industry would sooner or later abandon the cast aluminum parts then being used for oil pans and similar work, and replace them with steel stampings. The president of this stamping company reqested one of the press builders to submit a proposition on a large toggle drawing press for the work. The press was finally built. It stood idle on the stamping company's floor for a year or more before the automobile business developed to a point requiring stampings in such quantities as to warrant the making of the costly tools required for the production of the oil pans. The oil pans shown in Fig. 13 gives a fair idea of engine pans in general and similar work.

When the business did arrive, however, the buyers of the press were soon rewarded by the returns of the

investment to warrant the installation of the equipment and to demonstrate the successful vision that this particular manufacturer had of the future of the stamping line, and of the automobile requirements in particular. The toggle press in question weighed approximately 155,000 lb. Today machines of this type are built weighing upward of 300,000 lb.

### Examples of Toggle Press Work

A modern form of toggle drawing and deep stamping press used for making engine pans, radiators and similar articles of comparatively light gage metal, is shown in Fig. 14. It will be noted that this double action toggle press has two slides, an outer slide for clamping the blank and holding it under pressure while the work is being drawn, and an inner slide for doing the drawing, stamping and forming operations.

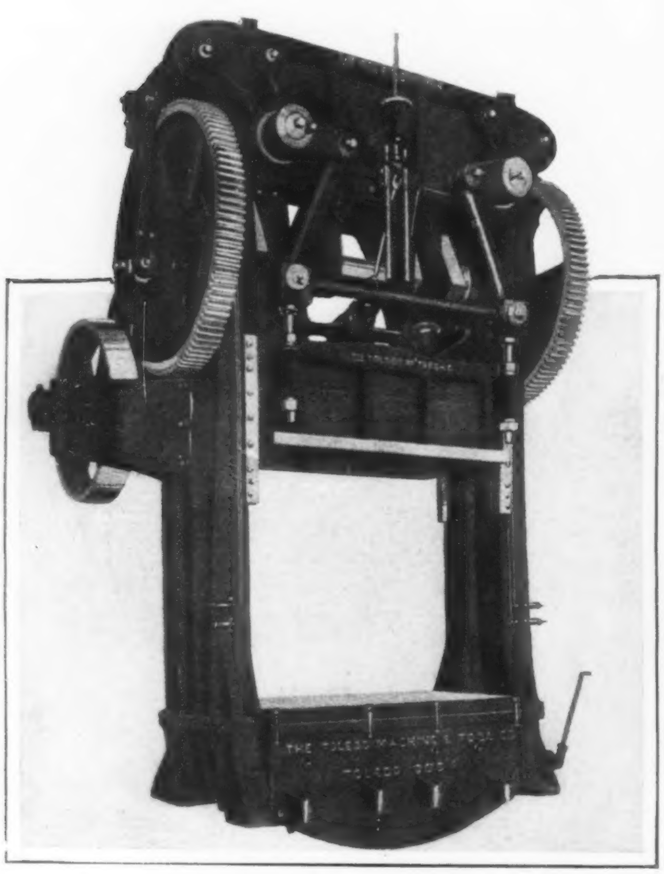


Fig. 16

An interesting example of toggle press work is the engine pan shown in Fig. 13. The size of the press required depends, of course, upon the size and shape of the engine pan, but the following operations are generally employed in making the average engine pan: 1. Blanking, done in a single-action double-crank press. 2. Drawing, done in a double-action drawing press. 3. Trim all around the flange. This is likewise done in a double-crank press. The holes in the flange are then pierced. Some of the minor operations, such as punching, shearing and notching, are frequently done in a small press with a removable bed, while the final re-striking operation is done in a large single action press like that shown in Fig. 7.

Another example of double-action press work is the radiator casing shown in Fig. 15. The ordinary operations would require about the same machines as the engine pan and would consist of the following: Blanking, drawing, trimming all around the edge, turning the edge up all around, expanding the hood ledge, cutting out the center opening and cutting the notches, lace holes and filler cap opening.

### Presses for Making Automobile Bodies

Double-action toggle presses are also made in the double-crank type with a considerable distance between the uprights and weighing as much as 600,000 lb. A modern form of double crank toggle drawing and deep stamping press is shown in Fig. 16. Presses of this type are noted for their smoothness of action, perfect timing, absolute dwell of the blankholder slide and the economical use of floor space, eliminating all outside slide and outboard bearings. Actual demonstration has proved the superior merit of this form of construction for all kinds of drawing deep stampings and forming operations in the manufacture of automobile bodies, cowls, crown fenders, large engine pans, front seats, hoods, large radiators, rear panels and a large variety of other work.

Fig. 15

Fig. 18

Fig. 17

In this press a powerful train of double gearing with twin gears at each end of the crankshaft operates the inner slide or drawing plunger in the usual manner. The outer or blank-holder slide is operated by cranks with universal connections on each of the twin gears on the crankshaft. Each crank is connected by a steel

link to a lever mounted in each end of the center of the crown, which is of heavy double web cross section. This construction permits of running large steel shafts from front to back of the crown. These shafts are for mounting the levers, which levers in turn connect with links controlling the toggle mechanism which is of very substantial construction, and is likewise mounted on heavy shafts also running from front to

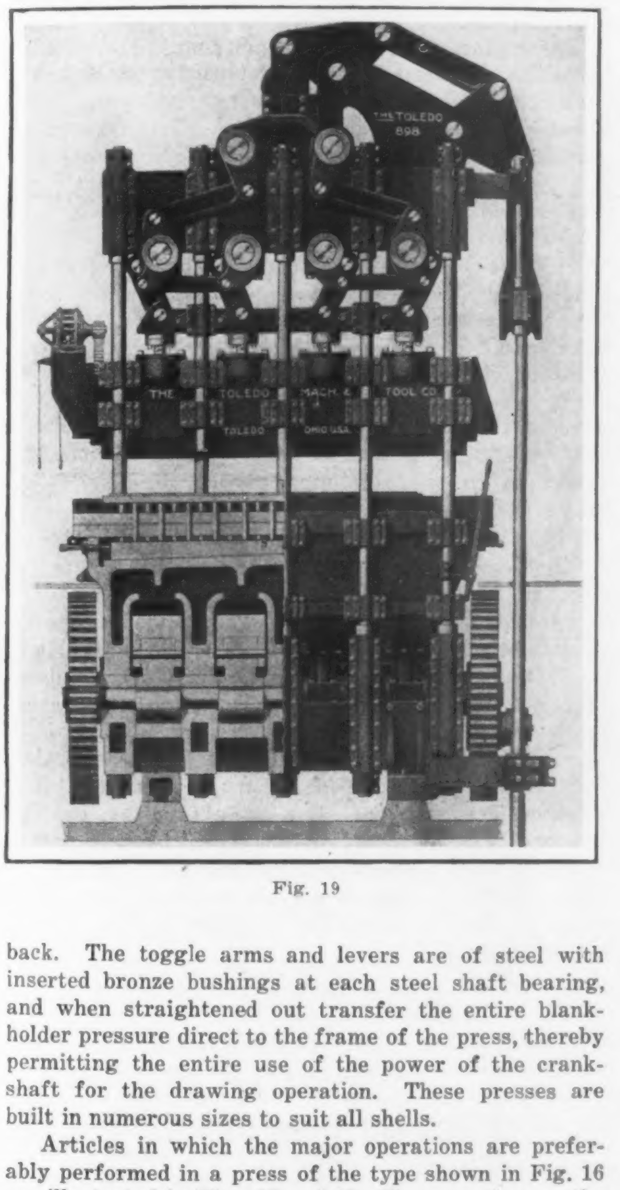


Fig. 19

back. The toggle arms and levers are of steel with inserted bronze bushings at each steel shaft bearing, and when straightened out transfer the entire blank-holder pressure direct to the frame of the press, thereby permitting the entire use of the power of the crank-shaft for the drawing operation. These presses are built in numerous sizes to suit all shells.

Articles in which the major operations are preferably performed in a press of the type shown in Fig. 16 are illustrated in Figs. 17 and 18. The operations on the side panel, Fig. 17, are substantially as follows: Blanking in a single action double crank press; drawing in a double-action double crank drawing press; trimming all around, in single-action double crank press; finish forming the flanges, in a single-action double crank press, and shearing the blank, in a suitable press, depending on the nature of the work. Back panels and sedan backs go through practically the same operations as the side panel. Other parts readily produced in double-crank toggle presses are shown in Fig. 18.

### Special Presses for Automobile Frame Work

The forming of channels and side rails for automobile frames and similar requirements has resulted in the designing of special presses. These presses are of unusual size, some of them having as much as 218 in. between the uprights, and are entirely self-contained. The largest size weighs 500,000 lb.

The side rails are preferably first blanked and sometimes perforated simultaneously in a double crank press. The forming operations are perforated in the special press illustrated in Fig. 19, which shows the machine as it appears above and below the floor line. The feature of this press is that the operation is diametrically opposite that of the ordinary toggle drawing and deep stamping double-action presses. The channel forming press has a movement entirely mechanical that brings the tools down and at rest on a flat blank or sheet by means of a toggle motion, and in this position the machine is capable of a resistance pressure equal to upward of 2000 tons. While this first toggle movement is at rest another movement is brought into play, forming the sides of the channel or frame. The machine in its operation completes the one cycle when the stamping lies on the face of the dies completely formed, with the result that the web or bottom of the stamping remains as flat as it would in the original sheet. In other words, the bottom or the web of the channel is held perfectly flat during the operation.

An interesting incident in connection with this operation, which resulted in the designing and building of this press, was that in attempting to produce shapes of this form and size on an ordinary standard type of double crank press it was found that where it required 200 tons to form up the sides of the channel it required more than 400 tons, or, in other words, double the power of the forming operation to prevent the bottom or solid web of the channel from buckling.

Several of these presses are in operation. They weigh upward of 600,000 lb. each. It has been demonstrated that with one of these presses five men will do the work of three hydraulic presses with 15 men, not

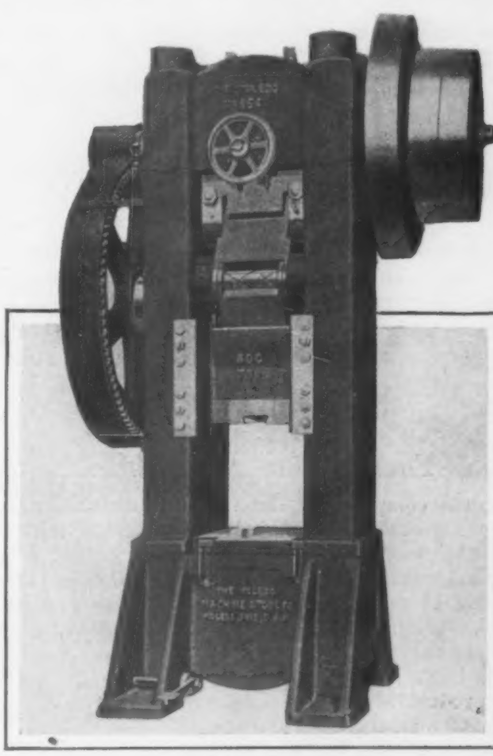

Fig. 20

considering the large force required to straighten the rails when hydraulic presses are used. It is sometimes possible to make two side rails at a time, one right-hand and one left-hand.

After the rail has been formed it is perforated in either the type of double crank press previously illustrated or in a lighter press fitted with a cam actuated clamping and stripping device, which permits of using shorter punches than with a stationary stripper.

### Knuckle Joint Press for Sizing Forgings

Sizing operations on certain forgings, eliminating machine finishing, have been referred to. This work is preferably performed on a knuckle joint press of the type shown in Fig. 20. Presses of this class are avail-

able in several sizes, some of them capable of exerting a pressure over 2000 tons. They are largely used for sizing steering knuckles, brake levers, connecting rods and other similar forgings and castings.

### Smoothing Out Wavy Stampings

Still another interesting feature that the automobile trade has developed is the smoothing-out process for certain of its stampings. We refer now to the tapered stamped steel radiator front, or casting, employed on some cars. Because of the slightly tapered form of this stamping, it was found difficult to produce the piece free from waves or buckles so that it would show smooth over the finally enameled and varnished surfaces. To meet these requirements a set of tools was developed to receive the finished stamping and allow a small space for water to flow just inside of the stamping around the steel form supporting it. The slide with the die was brought down on the work with a pressure of about 2000 tons on the outer surface of the stamping to prevent seepage or leaking. The pressure was held there while water was introduced in the small space between the work and the die through a small ¾-in. supply pipe by means of an accumulator with sufficient force to exert about 600 lb. pressure. This smoothed out all of the unevenness and waves in the original stamping, the water operation producing admirable results. The work was performed in a press similar to that shown in Fig. 20, but larger.

### Mechanical Press Used for Hot Pressed Work

The mechanical press, however, is not wholly confined to cold work. They are largely used for trimming drop forgings of all sizes, as well as for performing many forging operations and also for hot pressed work.

To cover this subject in detail would require volumes. In submitting the outline given above the endeavor has been to emphasize the importance of the press and die industry in its relation more particularly to the automobile field. The few incidents mentioned give an idea of how the requirements of the automobile and other industries assisted in the development of a line of power presses, special tools and machinery that in the last decade has practically revolutionized the manufacturing processes for the economical production of steel products, and has resulted in the substitution of stamped steel products for many articles that were formerly produced by other more expensive methods.

Outside of the automobile industry there are many interesting examples of pressed steel work. These include carriage bodies and seats, radiator sections, oil stoves, shovels, pails, barrels, caskets and many other products.

The engineering problems coming up in the pressed metal industry are so interesting that they deprive the work of the sameness frequently found in other lines of machinery manufacturing. The engineering departments of the various press building industries today are as eager and as interested in the work as at the time they started in as apprentices, and in some cases the interest is greater than that.

It is interesting to go into some of the larger factories engaged in sheet metal production and see rows of power presses in operation. In one plant there are more than a dozen presses, weighing over 225,000 lb. each, and numerous smaller machines. It is also interesting to see the remarkable operation of the tools that some of the stampers themselves have designed and built, producing a number of seemingly impossible operations in one revolution of the machine. The pressed steel industry is still in its infancy.

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The new electrical precipitator installed at Pueblo, Colo., by the Colorado Fuel & Iron Co., to clean blast furnace gas going into one stove was visited by a party of engineers on Dec. 17 and 18. The party included: D. B. Baird, superintendent blast furnaces, Steubenville Works, Wheeling Steel Corporation; D. Eppelsheimer, consulting engineer, American Rolling Mill Co.; N. H. Gellert, president, Gellert Engineering Co., Philadelphia; W. H. Oldham, superintendent blast furnaces, Tennessee Coal, Iron & Railroad Co., Ensley, Ala., and P. G. Wilander, superintendent blast furnaces, Wheeling Steel Corporation, Portsmouth. The gas is cleaned to 0.2 and less of a grain per cubic foot. The electrical cleaning plant was designed by the Gellert Engineering Co.

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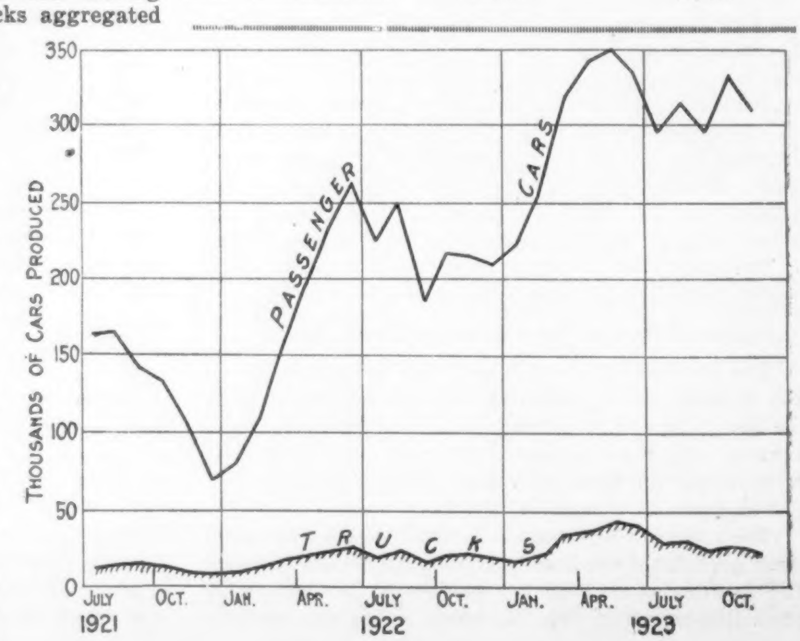
## Four Million Automobiles

Figures compiled by the Department of Commerce and revised since the original compilations show that during the first 11 months of 1923 the output of passenger automobiles amounted to 3,361,090 cars. During the same 11 months the output of trucks aggregated 348,330, making a total of 3,709,420 passenger cars and trucks in 11 months. On this basis it is anticipated that the total production for the year will aggregate about 4,000,000 vehicles.

November was the ninth month in succession in which more than 300,000 vehicles have been produced, the current figures being 284,680 passenger cars and 27,914 trucks, or a total of 312,594. Except for the eight months immediately preceding, this represents the largest month's output in the history of the industry.

Comparative figures for 1922, and for the last half of 1921, together with the 11 months of 1923, are shown in the table. In the first eight months of 1923 the number of passenger cars (2,442,476) and of trucks (261,612) exceeded the largest production of any preceding entire calendar year. The production of both cars and trucks is traced across the diagram also, the figures covering the 29 most recent months.

| | Passenger Cars | | Trucks | |
|---|---|---|---|---|
| | 1922 | 1923 | 1922 | 1923 |
| First 6 months... | 1,036,568 | 1,830,773 | 115,983 | 200,020 |
| First 11 months... | 2,131,758 | 3,361,090 | 225,927 | 348,330 |
| Year .............. | 2,339,768 | ........ | 246,281 | ...... |
| Last 6 months of 1921 | 789,624 | | 70,806 | |



# The Unbalanced Condition of Industry

## A Manufacturer Points Out That It Is to Be Reckoned With and Suggests That 1925 Will Bring Business Reaction

BY ALVAN T. SIMONDS*

ALVAN T. SIMONDS

I AM strictly opposed to the theory of many successful business men that the primary cause of good times is psychological and that by mere talk of optimism we may make business good, any more than temporarily at best. I believe in the Herbert Hoover theory that the only way we can cure the ill effects of the bottom of the cyclical movement is to take off the top of the mountain of prosperity. Just now I would emphasize to some extent the unbalanced conditions and even incline to what some people call the pessimistic side, but which I prefer to call the conservative side.

From Oct. 1, 1922, to Oct. 1, 1923, we had in the United States 100 per cent or capacity production. The limiting factor was that every available man in the United States who was willing to work was working to his fullest willingness. This condition was brought about in part by the highest tariff ever known and a very marked restriction in immigration, plus the fact that we have in the United States from 47 to 50 per cent of the world's gold with only 5.8 per cent of its population.

### The Distress of Europe

Frank A. Vanderlip, perhaps the best of our composite and practical business men, with well-grounded thinking on economics, made the statement in September, 1922, that the United States could go on with prosperity for a number of years regardless of Europe, in view of the fact that only 6 to 8 per cent of our total production is exported. His prophecy has been borne out to a large extent; but all of the theorists maintain that an unbalanced condition will eventually correct itself, and that is my personal belief.

Too little attention has been paid to the fact that at least $200,000,000,000 in wealth was destroyed during the war and that much of this amount is still outstanding as a mortgage on the next 35 or 40 years. Europe, generally speaking, has too much population and too little capital, whereas the United States has too little population and too much capital. Even during the past 60 days gold has continued to seek refuge in the United States on account of the continued political uncertainty of Europe; which only means that Europe as a whole is still, contrary to many business men's opinions, on the down grade. Outside of Russia, Europe produced during 1923 less grain than it produced 10 years ago, in spite of the fact that the population in the meantime has increased. During 1923, not mentioning the German mark, currencies of Belgium, France, Denmark, Norway and Spain have all lost more than 15 per cent of their exchange value.

In England more than 1,200,000 men have been constantly out of work throughout the past three years.

These are only a few instances of an unbalanced condition.

### Some Tendencies Suggesting Caution

While we are aware that the standard of living in the United States, for the past 50 years at least, has been higher than in any other part of the world, yet we are acting as if our standard of living had nothing whatever to do with the rest of the world, which of course is entirely fallacious.

Our proportion of the world's gold gives us an entirely inflated credit condition and is in itself dangerous.

Generally, good business should continue in the United States as long as credit conditions are satisfactory (which they are now) and as long as no outstanding calamity befalls Europe. The business I am in is largely dependent on the building construction program and for the greater part of 1923 has been a capacity business, with indications that it will continue so over the first half of 1924.

In spite of the fact that everybody who has prophesied a saturation point for automobiles has been wrong, it is certainly an unbalanced condition under which the United States can afford 14 million automobiles out of a total of 16 million in the entire world. While there is probably no such thing as an absolute saturation point for automobiles, it is entirely probable that a temporary halt will be called on this industry before the end of 1925. Inasmuch as this is such a large business today, anything untoward in it will immediately shake its weak manufacturers plus every one who supplies them with material, admittedly a very large group.

In the meantime business men do not pay enough attention to Irving Fisher's commodity index and to the fact that this index, even though we are now five years from the end of the war, followed almost absolutely the curves that were recorded after the Civil War and the Napoleonic Wars, and will be liable to follow these curves for the next 25 years.

The thing most needed today by the American business man is an up-to-date appraisal of his replacement cost, to determine his real net capital investment. How absurd it is to value the railroads at 19 billion dollars, the estimate made in 1913 or 1914, whereas the replacement cost, according to Fisher's commodity index, is certainly 50 per cent higher. And this is the amount upon which they must earn and translate their expenditures. Many other businesses are operating on a like basis. Whereas for 1922 the average per capita income in terms of the purchasing power of the dollar had fallen $12, or from $354 to $342, the income of the wage earner had increased 33 1/3 per cent.

### Reaction in 1925

At two different periods after the Napoleonic Wars and at two different periods after the Civil War soup lines were the vogue for three years at a time. We are going to get one of these periods some day. I would say that 1925 is about the time that we can look for a marked reaction.

The firm that does not involve itself in too much additional fixed capital nor obligate itself too far into the future for its circulating account will probably come out best in the long run.

*Mr. Simonds is president of the Simonds Saw & Steel Co., Fitchburg, Mass. He has been prominent as an advocate of a closer study of economics by business men, and has favored as a requirement of those who would undertake the management of large manufacturing enterprises that they give proof of their knowledge of fundamental economics.

# Trend of Improvements in Machine Tools

## Developments Gradual—Ease of Operation and Better Speed and Feed Ranges Features—Replacing Obsolete Equipment Profitable—Need for Training Skilled Workers

BY LUTHER D. BURLINGAME*

IN searching through back numbers of the mechanical press, covering a period of 40 years, one is impressed with the great development brought about during that time in the design of machinery and tools. This development, however, has been in the main a gradual evolution, an improving of fundamental designs which were already in existence 40 years ago, rather than producing radical innovations of an epoch-making character.

The most marked periods of mechanical development sometimes have been defined in terms of the product, such as periods when the sewing machine, the bicycle and the automobile respectively have dominated. While the radio is at present a line being widely exploited, its manufacturing requirements have not as yet had a marked influence on the types of machines used in machine shop work. The same can be said of other new discoveries and inventions. The manufacture of automobiles still dominates the field, as it has for many years.

Economists have repeatedly predicted that the "saturation point" had been reached in the manufacture of automobiles and that there would be a falling off in the demand. The number in use, however, has actually continued to increase beyond the most optimistic predictions, an authority having recently estimated that if the present rate of production is continued, in a period of a few years there will be more automobiles than homes in this country.

#### Room for Improvement in Speed and Feed Ranges

In the introduction to a recent English publication, "Mechanisms of Machine Tools,"† there is an outline of what is considered to be the trend of machine tool design for the immediate future. The following are some of the headings: Better speed and feed ranges; influence of high-speed steel; elimination of countershafts; motor drives; ball and roller bearings; automatic lubrication; form, and ease of operation. It is believed that these headings cover also important items of development in America, and we might add the possible influence of stainless steel.

While pioneers have pointed the way by adopting adequate ranges of speeds and feeds, arranged in geometrical progression, and although there has been marked development in that direction among leading machine tool builders, there is opportunity for added improvement. The present tendency is still in the direction of further provision of this sort, especially in view of the wider ranges required because of the increasing use of high-speed steel.

The widening use of high-speed steel calls, in addi-

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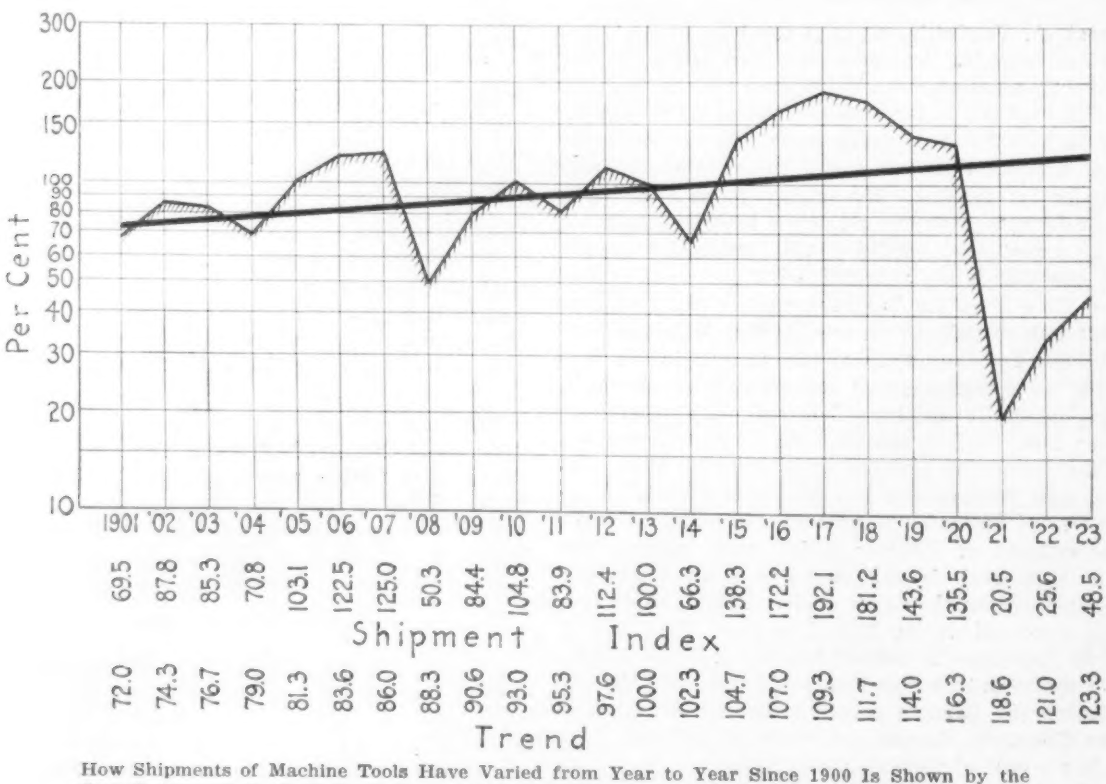
†By Thomas R. Shaw, published 1923 by Henry Frowde and Hodder & Stoughton, Lancet Building, London. The introduction is by P. V. Vernon.




How Shipments of Machine Tools Have Varied from Year to Year Since 1900 Is Shown by the Compilations of E. F. DuBrul, General Manager of the National Machine Tool Builders Association. He has also indicated by the heavy trend line (based on the years 1901 to 1914, inclusive) to what extent the sales of the past show a gradually increasing demand. Thus while shipments of 1921 were only 20½ per cent of those of 1913, consumption on the trend showing should have been 18.6 per cent more than 1913; hence the 1921 business was only 17.8 per cent of what it should have been, measured by 1913. The 1923 business is shown to be 48½ per cent of the 1913 volume but is only 41.7 per cent of the normal so-called

tion to the foregoing needs, for greater power and rigidity in machine design when using tools made of that material. While the use of high-speed steel has become so fully established that the main lines of machine tools have been designed so as to be adapted to its use, as already pointed out, the evolution has not as yet been completed and the coming year should show still further steps along these lines. Further, some tools, for example hobs for cutting gear teeth, when made of high-speed steel, introduce a need for grinding the hob teeth after hardening, in order to get the most satisfactory results, and thus call for additional operations and equipment. This is illustrative of many possible lines of development.

### Motor Drive Coordinated With Machine Design

The elimination of countershafts, made possible largely through the application of motor drives, provides for the convenient location or relocation of machines. It also keeps clear the overhead space for the use of cranes, and obviates obstruction of light and view. This also makes it possible to have all of the controls on the machine, resulting in greater convenience in starting, stopping and operating. In order that all classes of machine tools may be equipped for making use of motor drives, attention is being given to the design so as not to have the motor drive put on as an excrescence or as an afterthought, but to have it coordinated with the design of the machine, but still having the design such that there can be an option on the part of the customer as to which form of drive he will use.

The higher speeds and greater pressures brought about by the use of high-speed steel, and by provision to operate on brass and other of the softer metals at speeds giving maximum efficiency, are bringing about an increasing use of ball and roller bearings. Closely associated with this is the increasing tendency to provide automatic lubrication. This not only to provide for the increased speed and greater pressure but also to save the time of the workman and to avoid the destructive consequences of his neglect. The general use of such a method of lubrication in automobiles has no doubt pointed to extending its use in machine tools.

Associated with this provision for higher speeds is the use of a coolant circulated around the outside of bearings subjected to pressure or high speed for the purpose of keeping down the temperature, a feature also finding application in machine tools.

While it is many years since machine tool practice broke away from designs copying architectural forms it is only within recent years that careful study has been given to the principles which should govern in determining on the correct form and the proper distribution of metal. The features which are now having attention may be classified as follows: Supports, dealing with the designs of machine legs, cupboards, foundations, etc.; outline, where such features as massiveness, compactness, simplicity, form of outline, angles and ovals, are given consideration; symmetry, consistency in proportion and balance, including details such as brackets, arms, levers and handles; finish, having to do with paint or polish, treatment of surfaces, including style of cast lettering, broken joints and screw-heads.

### Providing Ease of Operation a Marked Tendency

One of the most marked of the present tendencies is, perhaps, in providing for automatic or semi-automatic operations on general purpose machines, which constitute the standard lines of machine tools, where such operations had previously been performed by hand. An illustration is the tendency toward providing power quick returns for milling machines, and a more recent example is in the development of fully automatic milling machines, thus bringing milling, as regards automatic control, into the same class as automatic screw machines and gear cutting machines.

The use of such machines assures maximum speed for idle as well as for cutting movements and relieves the workman of physical fatigue so that the tendency to ease off and lower production is minimized. It also is in the line of equipping for quantity production, toward which there has been a marked and increasing tendency following the activities of the war, with its lessons of production on a vast scale.

Such development of machine tools would indicate the further utilization of general-purpose machines by making them more convenient, so that they can compete with single-purpose machines for a wide range of work. It is believed that the experience of "unloading" following the war proved a lesson and a warning to some who had advocated an extended use of single-purpose machines as in many cases, when the readjustment came, such machines counted for but little as assets and have since been scrapped, while general-purpose machines have been usefully absorbed into industry. The retardation of new business among machine-tool builders due to the time required for the absorption of equipment dumped on the market from war stock has now largely passed into history and does not affect to any great extent the future prospects of this line of business.

It has also been reported that much of the large stock of American machinery and tools which was left in the hands of foreign agents following the war has since been absorbed, so that there is comparatively little remaining. As soon as settled conditions, or even a reasonable prospect of such, return there will be of necessity an urgent call not only for supplying the needs of customers abroad but also for replenishing these depleted stocks. While there is no present prospect of this settled condition in Europe being brought about in 1924, we can hopefully predict that it will come some time in the not very distant future and that when it comes those that are prepared for it will be the ones to reap the harvest.

Without doubt important uses of stainless steel are being found and success therewith will result in its widely extended use, the time required to bring this about depending largely on the cost as compared with that of materials now used. The application of stainless steel may be more noticeable in its use for machinists' measuring tools, etc., than in its embodiment in machine tools, or of the requirement for a modification of their design to provide for its use.

### Use of Improved Tools Will Stimulate Design

If it is permissible in a forecast to propose a constructive program of what should be the trend of machine-tool design in 1924, a suitable text might be, "It Pays to Replace." This was the subject in a recent competition among readers of the *American Machinist* for prizes offered for the best article. The writers, representing many lines of manufacture in widely separated parts of the country, pointed out conclusively that a liberal policy in putting in new equipment in place of that which has become obsolete, and adopting up-to-date methods in place of such as have existed without change for many years, not only can result, but in case after case cited has resulted in cutting the cost to a remarkable degree. To the degree that American industry adopts a program of tuning up equipment for 1924 will there be improved designs and activity in sales.

Several programs are under way which should stimulate manufacturers to have a thorough house-cleaning during the year 1924, eliminating obsolete machines and methods, and replacing them with what is up-to-date. A vast amount of work is being done on machines not adapted to doing it most efficiently. One of

the most forceful pleas made by Herbert Hoover in his efforts to stabilize and improve business conditions since he became Secretary of Commerce has been for the elimination of waste. Uneconomical production with equipment not best adapted to the work is certainly one of the great sources of avoidable waste.

Another activity centering in the Government which should have a helpful influence on the prosperity of the machine-tool industry during the coming year is the preparedness program by which manufacturers are agreeing to put and keep their shops and equipment in a condition of efficiency. This, although intended primarily as a peace measure and as an insurance against war, is also a war measure in that if the country is forced into war maximum production can be reached at the earliest possible moment. To the extent that manufacturers cooperate in carrying out this plan will the machine-tool interests be stimulated to greater activity.

### Standardization Will Cause Developments

More active work is being done in the direction of standardization than ever before in mechanical history. To carry out an adequate program means important development in the field of machinery and tools, because it will mean raising the standard of workmanship and will require the use of higher grade tools, in order to assure interchangeability. For example, the establishment of standard tolerances for screw thread products and for cylindrical work, so that the product of one manufacturer will interchange with that of another, while in the long run a great step toward economy will mean in many cases an initial outlay.

There will be an increased call for ground taps and hobs, ground cutters for gears, etc., and also a greater call for refined measuring tools. This tendency toward greater refinement will also be evident in an increased demand for high-grade, quiet-running gears, including the use in many places of ground gears. The introduction of centerless grinding, a process adapted to bring additional work within the range of economical grinding processes is also having its influence.

### Better Organized Trade Training Needed

In spite of the fact that the machine-tool industry is now working below its normal capacity there is still a scarcity of experienced and skilled workers. That there is a realization on the part of those who face the facts and look into the future of the need for better organized trade training for the machine-tool industry than now exists is shown by the steps taken at the last annual meeting of the American Safety of Mechanical Engineers. At this meeting representatives of industrial establishments and leading educators discussed this need and put in motion a plan to develop a more active program for training to produce skilled workers, with the specific thought of making it a training of skilled workers for the industries, not for "white collar jobs."

# Quarter Century of Iron and Steel Production

## Pig Iron, Steel Ingots, Rails, Plates and Sheets, Bars and Structural Steel Made Since 1898

IN the accompanying chart and table the United States production of pig iron, steel ingots, both open-hearth and Bessemer, and four items of finished steel are traced over the past 25 years. The four items include rails, which were highest 25 years ago and lowest today of the four in the group; structural steel, lowest of all 25 years ago, but now above the rails; plates and sheets (taken as a group) and bars. The bar figures were not available prior to 1905.

Among the noteworthy changes which have taken place during this period are the rapid increase of ingot production until it passed the pig iron output in 1912, for the first time, and then passed it permanently in 1915; the still more rapid increase in the production of open-hearth steel, until the tonnage passed that of Bessemer steel permanently in 1908 and actually passed the pig iron tonnage figures in 1922, only to lose the lead again in the year just elapsed.

Similarly, the tonnage of plates and sheets passed the rails in 1904 and the bars in 1906, and has since held the lead as the highest item of finished steel. This, of course, would not be true if the plates and the sheets were considered separately from each other. Bars have been above rails consistently ever since the figures have been compiled, with the sole exception of 1921, when they fell temporarily below, rebounding in 1922 to a figure far above that for rails. Structural steel passed above the rail figures in 1914 and, except for 1921, has since continued above.

Pig iron this year is making a new high record, passing the large wartime figure of 1916 by a comfortable margin of nearly 1 per cent. The tonnage this year is virtually three times that of 1899. The total steel ingots, while not making a new record this year, will yet be close to the high record of 1917 and should exceed the 1918 figure of 43,051,000 tons, the second highest production we have ever recorded. This represents more than four times as much steel as was produced in either 1899 or 1900.

Open-hearth steel has advanced still more rapidly, the 1923 production, now estimated at about 34,400,000 gross tons, a new high record, being more than 12 times as great as the 1899 figure. It is about the same as the figure for all ingots in 1922, and is far higher than the largest production of either ingots or pig iron prior to 1916. Bessemer ingot tonnage, now estimated at 8,800,000 tons, while higher than in 1899 or 1900, is lower than in most of the years between 1902 and 1918. It is more than double the figure of 1921, although only 72 per cent of the high record figure of 1906.

Coming to the finished steel, rails are about on the plane of the opening years of the twentieth century, but are much lower in tonnage than the three big years 1905, 1906 and 1907, or the years 1910, 1912 and 1913. Production of plates and sheets has more than quadrupled since the beginning of the quarter century under review. The highest figure which we have seen was that of 1920, with 9,338,000 tons. The present year will not reach that high record; sheets are being produced heavily, but plates are not. Bars have had an erratic course, beginning in 1905 with 3,600,000 tons, reaching about 6,600,000 tons in the last three years of the war and again in 1920, and with a similarly high figure in the year just past. But two of the intervening years—1908 and 1921—the figure was below 2,000,000 tons. Structural shapes have advanced from less than a million tons at the beginning of our review to the maximum (so far reported) of 3,307,000 tons in 1920. The figure for 1923 may reach or exceed that amount.

Although 1923 will not prove to have been a record year for production of finished iron and steel, yet it will be perhaps our second largest year. And the small percentage of these products which have been exported leaves the domestic consumption higher by nearly 15

*Iron and Steel Production in Gross Tons*

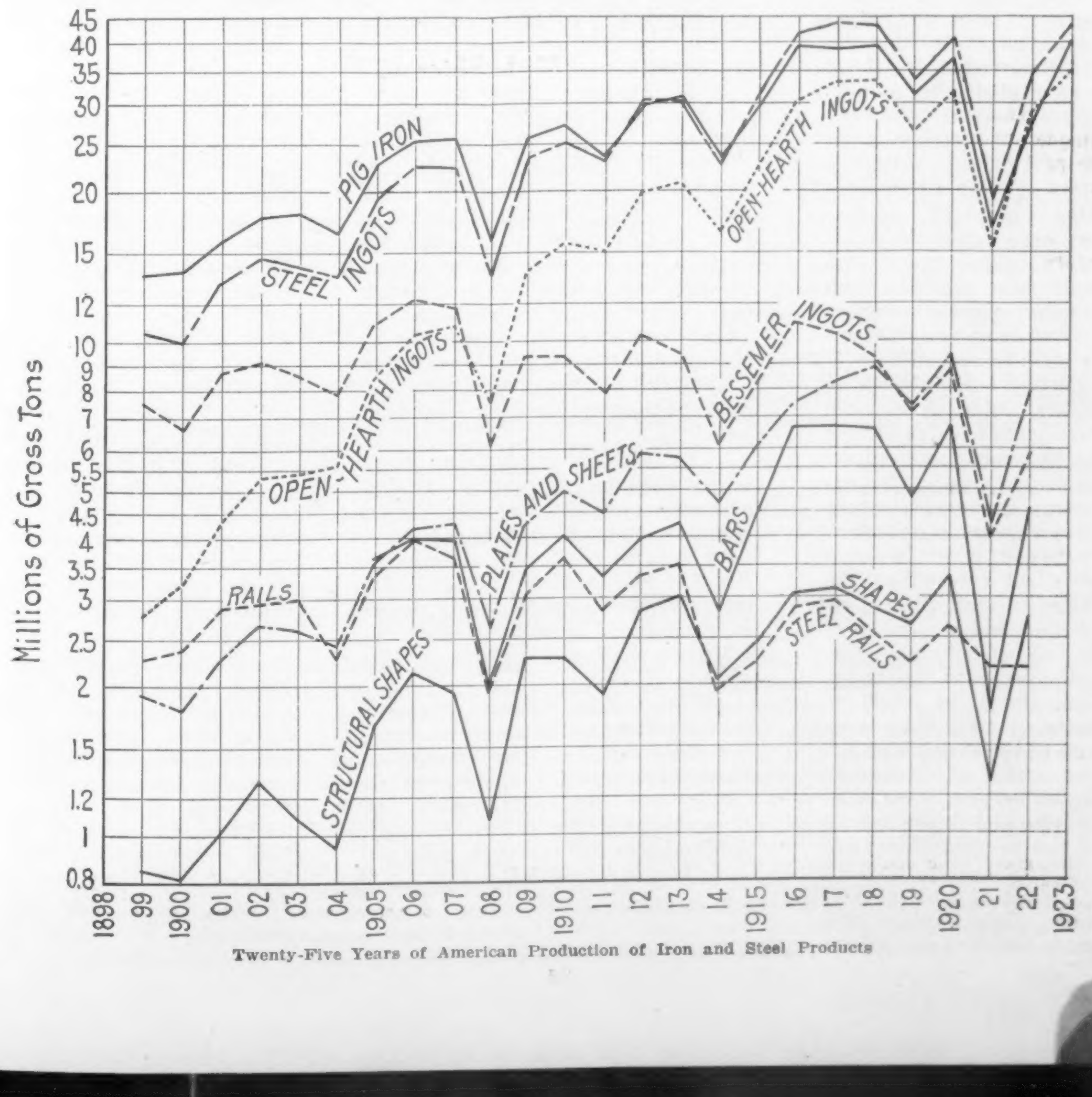
| Calendar Year | All Pig Iron | Steel Ingots: Total | Steel Ingots: Open-Hearth | Steel Ingots: Bessemer | Finished Rolled Products: Rails | Finished Rolled Products: Plates and Sheets | Finished Rolled Products: Bars | Finished Rolled Products: Structural Shapes |
|---|---|---|---|---|---|---|---|---|
| 1899 | *13,620,703 | *10,458,745 | *2,777,587 | *7,582,415 | *2,272,700 | *1,903,505 | (*b*) | *850,376 |
| 1900 | *13,789,242 | 9,995,526 | *3,220,644 | 6,678,303 | *2,385,682 | 1,794,528 | (*b*) | 815,161 |
| 1901 | *15,878,354 | *13,156,025 | *4,354,687 | *8,706,538 | *2,874,639 | *2,254,425 | (*b*) | *1,013,150 |
| 1902 | *17,821,307 | *14,556,315 | *5,319,850 | *9,125,815 | *2,947,933 | *2,665,409 | (*b*) | *1,300,326 |
| 1903 | *18,009,252 | 14,104,713 | *5,429,563 | 8,574,730 | *2,992,477 | 2,599,665 | (*b*) | 1,095,813 |
| 1904 | 16,497,033 | 13,529,676 | *5,605,332 | 7,843,089 | 2,284,711 | 2,421,398 | (*b*) | 949,146 |
| 1905 | *22,992,380 | *19,463,180 | *8,444,836 | *10,919,272 | *3,375,929 | *3,532,230 | 3,593,601 | *1,660,519 |
| 1906 | *25,307,191 | *22,624,431 | *10,260,522 | *12,243,229 | *3,977,887 | *4,182,156 | *3,992,200 | *2,118,772 |
| 1907 | *25,781,361 | 22,559,477 | *10,803,211 | 11,634,276 | 3,633,654 | *4,248,832 | 3,970,988 | 1,940,352 |
| 1908 | 15,936,018 | 13,677,027 | 7,524,952 | 6,096,196 | 1,921,015 | 2,649,693 | 1,986,638 | 1,083,181 |
| 1909 | *25,795,471 | *23,298,779 | *13,892,896 | 9,296,969 | 3,023,845 | 4,234,346 | 3,422,883 | *2,275,562 |
| 1910 | *27,303,567 | *25,154,087 | *15,641,158 | 9,354,437 | 3,636,031 | *4,955,484 | *4,026,840 | 2,266,890 |
| 1911 | 23,649,547 | 23,029,479 | 15,027,459 | 7,890,753 | 2,822,790 | 4,488,049 | 3,306,103 | 1,912,367 |
| 1912 | *29,726,937 | *30,284,682 | *19,909,875 | 10,259,151 | 3,327,915 | *5,875,080 | 3,971,446 | *2,846,487 |
| 1913 | *30,966,152 | 30,280,130 | *20,689,715 | 9,465,200 | 3,502,780 | 5,751,037 | *4,277,279 | *3,004,972 |
| 1914 | 23,332,244 | 22,819,784 | 16,570,367 | 6,154,964 | 1,945,095 | 4,719,246 | 2,812,102 | 2,031,124 |
| 1915 | 29,916,213 | *31,284,212 | *22,943,770 | 8,194,737 | 2,204,203 | *6,077,694 | *4,484,650 | 2,437,003 |
| 1916 | *39,434,797 | *41,401,917 | *30,238,978 | 10,916,248 | 2,854,518 | *7,453,980 | *6,691,702 | *3,029,964 |
| 1917 | 38,621,216 | *43,619,200 | *32,935,737 | 10,320,688 | 2,944,161 | *8,267,616 | 6,681,141 | *3,110,000 |
| 1918 | 39,054,644 | 43,051,022 | *33,318,561 | 9,215,392 | 2,540,892 | *8,799,135 | 6,587,369 | 2,849,969 |
| 1919 | 31,015,364 | 33,694,795 | 26,186,174 | 7,172,743 | 2,203,843 | 7,372,814 | 4,810,645 | 2,614,036 |
| 1920 | 36,925,987 | 40,881,392 | 31,685,495 | 8,778,107 | 2,604,116 | *9,337,680 | *6,702,685 | *3,306,748 |
| 1921 | 16,688,126 | 19,224,084 | 15,155,357 | 3,977,129 | 2,178,818 | 4,260,574 | 1,792,982 | 1,272,624 |
| 1922 | 27,219,904 | 34,568,418 | 28,478,235 | 5,871,565 | 2,171,776 | 7,968,397 | 4,552,474 | 2,718,768 |
| (*a*) 1923 | *40,000,000 | 43,300,000 | *34,400,000 | 8,800,000 | ........ | ........ | ........ | ........ |

(*a*) Estimated from data available Dec. 28, 1923. (*b*) Not reported separately, prior to 1905. *New record.

per cent than in any previous year in our history. This is shown on another page, where the percentage of exports of rolled iron and steel over the past 14 years is analyzed and where it is shown that, for the first time, the production of these materials for domestic consumption has gone far past the 30,000,000-ton mark.

In the table an asterisk has been placed alongside each figure which represents a new yearly record in production. It is interesting to note that the first nine years of the period, and all but three of the first 20 years thereof, showed new records in open-hearth steel. And in each of the three cases where a record was not made, the reaction of the following year produced a new record. This illustrates most strikingly the tremendous impetus of that material, once it had proved itself, and the facilities for its rapid and inexpensive production has become available.

Pig iron showed 13 new records in the first 20 years of the period, and has added a fourteenth in the year just past. Total steel ingots have 11 record years in the first 20; rails show seven in the first eight, with none since the big year of 1906; plates and sheets have made 13 records and structural shapes 11, in the whole period, without reference to their 1923 results.




Twenty-Five Years of American Production of Iron and Steel Products

# Long Hours in Steel Industry Reduced

## Men Generally Satisfied with the Changes—Uncertainty as to Effect on Costs—Test Will Come When Demand for Products Increases

THE outstanding event of the year 1923, so far as the relations of employers and employees in the steel industry are concerned, was the decision of the leaders to abolish the 12-hr. day as urged by President Harding.

This decision was promptly followed last August by the beginning of the establishing of the shorter hours by companies representing a large percentage of the iron and steel manufactured in the United States. Although it was soon apparent that the United States Steel Corporation was making rapid progress and that some independents were doing fully as well, there has been much doubt as to what has really been accomplished. Labor agitators have not hesitated to assert that only a small percentage of the employees have been put on shorter hours and that the whole movement is a bluff to accomplish ulterior purposes. There has also been considerable reticence on the part of some manufacturers as to what they were doing, probably because they were feeling their way before taking steps that would mean much to them in financial and other ways.

THE IRON AGE, through its staff representatives in important manufacturing centers, has made a careful investigation to determine exactly what has been accomplished in this important movement, which followed years of agitation. The result, given in detail below, shows that the United States Steel Corporation and a number of the independents have virtually completed the change from the 12-hr. shift to shorter hours. The estimate of the Pittsburgh district is that all of the employees of the Steel Corporation and 70 per cent of the independent plants are now working less than 12 hr., while at Chicago and some other centers the change has been carried out with admirable zeal to an even greater extent.

Definite and final information as to additional cost of making steel under the new conditions may not be available for a year or more, but up to date the estimate that the cost of making a ton of steel is from \$2 to \$3 a ton higher seems to be fairly accurate. This increase is largely in the steel works and rolling mills, some blast furnace operators having made the change at a surprisingly small increase of cost.

As to the effect of the change in improving the relations of employers and employees, there is strong testimony that despite some temporary dissatisfaction owing to the reduction of wages, men, as a rule, are now thoroughly satisfied and some of them, as is shown in the testimony of the steel workers in the Buffalo district, are enthusiastic because they have more time to spend at home and in recreation. Efficiency has increased at many plants, but whether this is due to the shorter hours of work or to the fact that the demand for labor has decreased has not been clearly established.

The most ardent advocate of short hours for labor could not deny that manufacturers have some serious problems ahead of them. One of them is how to deal with the negroes and others who have been employed as the result of the present immigration policy and of the abolishing of the 12-hr. system. The most important problem of all is to determine how the 8- and 9-hr. shifts can be made permanent, for undoubtedly the time will come when furnaces and mills will find it difficult to meet the demand for their products.

The change has not been easily made, but has involved an immense amount of thinking and planning. The greatest promise of permanence is

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### President Grace Gives Credit to Employees—Never Had Better Spirit

BY E. G. GRACE
President Bethlehem Steel Co.

*I AM glad to advise you that the 12-hr. day has been practically eliminated from the steel plants of our company.*

*Entering the year* 1924, *less than* 2 *per cent of our entire force of steel plant employees will be working over* 10 *hours per day, and the hours of these employees will be changed as soon as operating conditions will warrant.*

*The changes in hours and wage rates occasioned by the elimination of the 12-hr. day were started in the middle of August, and the satisfactory progress that has been made in this important development has been due to a great extent to the earnest efforts which our employees have made, through the Employees' Representation Plan, to assist us in the solution of the many anticipated problems arising out of such a vitally important change of a long standing practice.*

*The fact that we have not been under constant pressure for full capacity production since the changes were begun has been a very helpful factor in accomplishing the elimination of the 12-hr. day, but this condition also makes it difficult to anticipate what the ultimate economic effects of the change will be.*

*While this change requires many employees to work more intensively on the shorter day, we have never had a better spirit among our employees, and I feel that the additional leisure time afforded them will prove socially and industrially beneficial.*

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found in the plants where the preliminary work was most thoroughly done and where the officials and superintendents are most heartily in favor of shorter hours.

George H. Charls, speaking of the experience of the United Alloy Steel Corporation, Canton, Ohio, of which he is vice-president and general manager, says:

"I am convinced that it should be easier for steel plants comprising sheet mills to work out an 8-hr. day properly than those which do not; because sheet mills have been operated on the 8-hr. day for almost a decade.

"Our plant comprises a total of 41 sheet mills. These have always been operated on a three-shift system and give years of experience from which one can draw in working out the three-shift system in other divisions.

"We introduced the 8-hr. day in our open-hearth department Sept. 1, and followed with the blooming mill, bar mill and blast furnace divisions, as soon as the proper studies could be completed. These departments are now operating on the three-shift system satisfactorily.

"My opinion of the change is that it was made at the psychological moment, and that it is a splendid thing for the welfare of the men, even though it involves an increase in cost.

"So far, we have been able to hold the increase in cost to a minimum by making a very thorough time study and attempting to work out the same system of team work which has proved itself in the sheet mill division.

"The crucial test of the three-shift system, known as the 8-hr. day, will come when business resumes its normal stride. Until that time, it will be very difficult for any one to measure definitely the results."

# Long Day Has Almost Disappeared in Chicago District

CHICAGO, Dec. 31.—The elimination of the 12-hr. day by Chicago district mills and blast furnaces has been much more rapid than was originally expected. At first it was conservatively estimated that a complete change to the new basis of operations could not possibly be effected for a year. As a matter of fact, however, the 12-hr. shift has been entirely eliminated in all United States Steel Corporation plants and with very few minor exceptions is now a thing of the past also in all other steel works, as well as merchant blast furnace plants. The additional number of employees required under the new plan is indicated by the fact that at the time the two-shift basis was abandoned the Inland Steel Co. had 5200 men on its payroll and 1400 had to be added, making a total of 6600, an increase of 27 per cent. Chicago district producers are unwilling to commit themselves as to the increased cost of production attributable to the elimination of the 12-hr. day. They point out that many of their new men were, and still are, green and that the rate of operations latterly has not been comparable with that earlier in the year. A fair estimate of the increased cost can be made only after they have had added experience with the new plan. For similar reasons it is difficult to determine whether production per man per hour is greater on the present basis than under the old plan.

The consensus of opinion, however, seems to be that the workmen are performing their tasks with more zest and enthusiasm than when they were working longer hours.

### Attitude of the Employees

There is also some difference of views as to the attitude of the men themselves toward the change. Most executives are frank to state that the workmen prefer the shorter shift, but one important producer is of the opinion that fully one-half of his employees would prefer the 12-hr. day because of higher total daily earnings. He admits that "family" men and their dependents probably both appreciate the added time that the workmen are able to devote to their homes. On the other hand, the families of those employees who fritter away their time and money on liquor and gambling undoubtedly regret the fact that these men have additional hours to devote to such habits. The same executive voices the opinion that it is regrettable that 10-hr. shifts cannot be arranged in the continuous processes. The 10-hr. period of employment, he believes, is a far more satisfactory turn from the standpoint of the men themselves than the shorter 8-hr. shift. For the average common laborers in their present state of enlightenment, he says, idleness is an invitation to get into mischief.

### Convincing Testimony

Perhaps the most convincing testimony to the fact that the men prefer the shorter day is the experience of the Wisconsin Steel Works, South Chicago, which has been on a three-shift basis for some time. In fact, the continuous processes at that plant were put on a three-shift basis approximately nine years ago and in June, 1919, the machine shop employees, yard laborers, and the like, who had been working ten hours were also placed on an 8-hr. turn. These men although working only eight hours, were paid ten-twelfths of the wages of the workmen employed in other plants on 12-hr. shifts; yet although their daily wages were less than those for the long shift, the company found no difficulty in keeping its employment rolls filled. The payment of a higher hourly wage than by mills on a long turn basis was partly offset by the fact the labor force was not increased 50 per cent but only 35 per cent. The manner of handling given tasks was so revised that fewer men would suffice than under the old system. There was also some increase in tonnage output per man. At times the increase in production has been sufficient almost, though not quite, to keep labor costs down to a parity with those under the two-shift plan.

It is the opinion of some producers in the Chicago district, although others are non-committal, that the introduction of the shorter day has resulted in a permanent improvement of the personnel of the employees.

# Substantial Progress in the Pittsburgh District

PITTSBURGH, Dec. 31.—A careful checkup of the Pittsburgh-Wheeling-Youngstown district indicates that the elimination of the 12-hr. day in the steel industry is at least 70 per cent completed among the independent plants as an average and almost 100 per cent accomplished in the Steel Corporation units in that area. At the inauguration of the movement on Aug. 16, the Steel Corporation moved with a great deal more speed in the adoption of the late President Harding's suggestion than did the independent companies and this alinement has persisted through the four and one-half months that the movement has been in progress. The conclusion, however, must not be drawn that the record of the Steel Corporation finds no parallel among the independent companies, for there were at least three companies in the Youngstown district, which had partially eliminated the long workday in the departments of continuous operation even before the industry as a whole decided upon the change and these companies now are little, if any, behind the Steel Corporation in the actual application of the shorter day. It cannot be gainsaid that the movement has made commendable progress and the fact that there are today only a few blast furnaces—and these of the "merchant" classification—which still are being operated on two 12-hr. turns, attests the sincerity of the industry in adopting the change and at the same time quiets suggestions emanating from organ-

ized labor circles that the whole effort is little more than a gesture and a temporary one at that.

**Helpful Factors in Making the Change**

Of considerable assistance in effecting the change, of course, has been the fact that the industry as a whole has operated at a lower rate since the middle of August than it did prior to that time and the weather so far has not been harsh enough to cause much depletion in the ranks of the negroes brought North in such large numbers to fill the gaps created by the extra shifts so generally put on in the continuously operated departments, in which elimination of the 12-hr. day found its most simple solution in the setting up of three 8-hr. turns. Cold weather will no doubt cause many negroes to leave for their Southern homes and the recurrence of rush times in the steel industry may possibly set up a problem in the form of a fresh shortage of labor. "Sufficient unto the day, is the evil thereof," however, and having already to an unexpected degree solved the greater problem of getting rid of the long workday, the industry may be trusted to find the way out of lesser and probably temporary difficulties.

It was stated in THE IRON AGE when the change was adopted that it would probably require a full year to completely eliminate the 12-hr. day; there is no occasion for material modification of that statement, nothwithstanding that the movement has made more progress to date than was generally expected at first. There must be further reduction of the number of men required for a given task and that involves the introduction of labor-saving devices. This, of course, takes time and constitutes a problem at those plants that have become more or less obsolete, and there are many such plants in this area. The more modern the plant, the fewer the men required for a definite task and the greater the elasticity of a given number of men. Only an approximation of what the change has meant in costs, therefore, is possible until all 12-hr. work has been eliminated.

**Cost of Steel Making Increased**

It was estimated in August that the change meant an increase in the cost of making steel of from $2 to $3 per ton and experiences thus far have led to no modification of these estimates. The head of one independent company in this district, operating a modern and self-contained plant, says that the increase will be at least $3 a ton. The work at by-product coke plants being of continuous character, it has been found necessary to increase the number of men employed by fully 40 per cent; setting up a 10-hr. day for such work was not feasible, for that would have meant, if not a lapse between turns, at least a period when full attention to the coking of coal would not have been possible. Likewise, in the operation of blast furnaces, the three 8-hr. turn system formed the natural solution of the problem of making the change. While there are instances where this meant increasing the force by as much as 50 per cent to create a third shift and avoid the necessity of any one turn working more than six days a week, it has been common practice to make slight reductions in the number of men per turn and to build up the third shift from the original employees and the adding of new men. Open-hearth departments also have been placed on three 8-hr. turns and here the solution has largely been in the reduction of the number of men per turn, supplemented by a few additions. There may be a few companies which have escaped material increases in the cost of making steel, but they are decidedly in the minority.

**Men Are Satisfied**

As to the effects of and the reactions to the changed working schedules among the workmen, it is the testimony of most plant officials that the men now are completely satisfied and thoroughly reconciled to the smaller remuneration. It will be recalled that when the change was first attempted, there was considerable opposition among the men to the shorter day, which, although it carried with it a higher hourly rate than the long day, at the same time meant smaller total pay. It was not how long they worked, but what they earned that counted with these men; seemingly, however, the fact that they now have more time for themselves and their families has gone a long way toward offsetting the loss of pay.

**Efficiency Increased**

It is generally subscribed to that the men are a good deal more efficient than they were on the longer workday, but this is merely citing the obvious. Despite the frequent "spells" under the old working schedules, those who have worked them are not slow to declare that there was not much energy left for the last four hours of duty. While some steel company officials observe that the men are not particularly enthusiastic about the shorter working hours and that they have taken the change merely as a matter of

## *Steps in Abolishing the Long Day*

**May 18, 1922:** *White-House conference of 40 Members of the American Iron and Steel Institute sits with President Harding, upon his invitation, to discuss the abolition of the 12-hr. day.*

**May 26, 1922:** *Committee of nine appointed by Judge Elbert H. Gary to make a "careful and scientific investigation and to report to the steel industry conclusions and recommendations regarding the 12-hr. day."*

**May 25, 1923:** *American Iron and Steel Institute reports that "if labor should become sufficient to permit it, the members of this committee would favor entirely abolishing the 12-hr. day, providing the purchasing public would be satisfied with selling prices that justified it."*

**June 18, 1923:** *President Harding in a letter to Judge Gary urges abolition of the two-shift system.*

**June 27, 1923:** *American Iron and Steel Institute directors assure President Harding that the 12-hr. shift will be abolished at the earliest time practicable.*

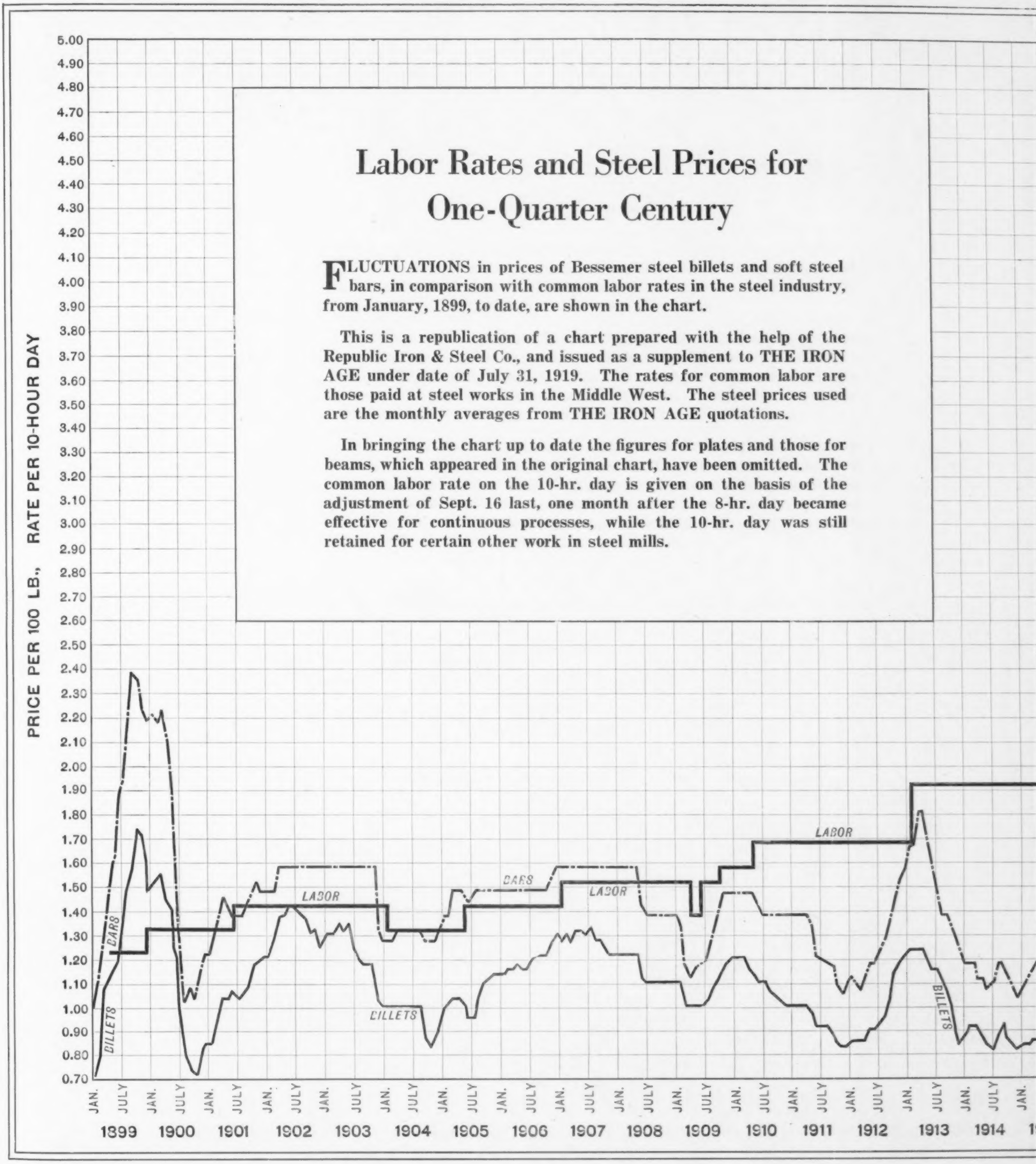
**Aug. 16, 1923:** *Carnegie Steel Co. starts to establish the 8-hr. day, and other companies take initial steps to abolish long day.*

# Labor Rates and Steel Prices for One-Quarter Century

FLUCTUATIONS in prices of Bessemer steel billets and soft steel bars, in comparison with common labor rates in the steel industry, from January, 1899, to date, are shown in the chart.

This is a republication of a chart prepared with the help of the Republic Iron & Steel Co., and issued as a supplement to THE IRON AGE under date of July 31, 1919. The rates for common labor are those paid at steel works in the Middle West. The steel prices used are the monthly averages from THE IRON AGE quotations.

In bringing the chart up to date the figures for plates and those for beams, which appeared in the original chart, have been omitted. The common labor rate on the 10-hr. day is given on the basis of the adjustment of Sept. 16 last, one month after the 8-hr. day became effective for continuous processes, while the 10-hr. day was still retained for certain other work in steel mills.



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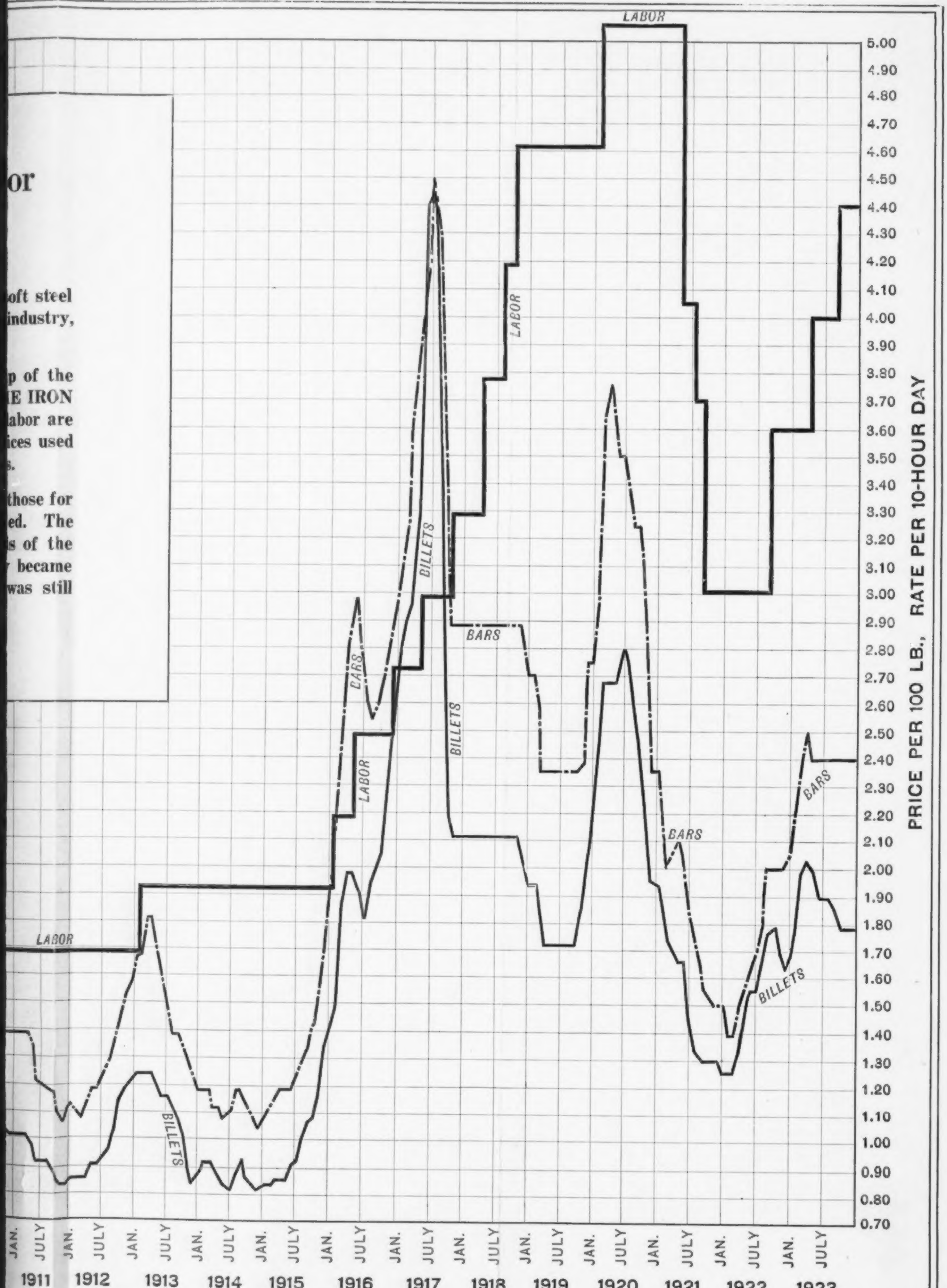


course, this is probably a long-range opinion and is not often heard among the men in actual charge of the plants. Regardless of the differences of opinion as to how the men take to the new schedules, it is an interesting and encouraging fact that the change has made work in the steel plants more attractive to young men who were headed toward white-collar jobs. In the old days in Pittsburgh, the steel industry paid as well as others and as it provided more steady employment, rarely suffered for want of men and it was common for sons to follow their fathers in the industry. But as time went on, other lines of work became more attractive from either the remunerative or hours of labor standpoint and the steel industry lost recruits. Some now are optimistic enough to believe that the step taken by the steel industry as to working hours and pay will do much to restore its former attractiveness to intelligent labor.

### The Negro in the Steel Industry

The place of the negro in the steel industry still is in doubt. In many instances the colored men are satisfactory, but this statement is not applicable, based on the testimony of steel plant managers, to those who have been brought North in the recent past. Most of these colored men had spent their lives in the open, working on farms and plantations, and the noise of a steel plant wears on them. The Northern winters are too harsh for them and the lure of the Southern cabin, his "dawg" and the pursuit of the opossum overcomes his willingness to stay in the North.

## Steel Workers at Buffalo Heartily Commend the Change

BUFFALO, Dec. 31.—While the long working day has not been entirely eliminated in this district, progress of a satisfactory character—satisfactory to both employees and executives—marks the efforts to date. One blast furnace operator has eliminated the 12-hr. shift entirely and the entire working force is now on a 10 or 8-hr. schedule.

It is expected the new schedules will materially assist in eliminating labor turn-over. Only one company is in position to state that the change has been made without increased cost of operation. The whole situation has been helped through the fact that labor has been more available in recent weeks than earlier in the year. Reduced operations in iron and steel and other industries in Buffalo put thousands at the call of iron and steel mills.

THE IRON AGE has obtained interesting expressions of opinion from two steel workers in regard to the abolishing of the long day.

### Declared a Complete Success

The first is an article written by a representative of the men on the open-hearth floor.

"The establishing of the 8-hr. day, as carried out by the Donner Steel Co. here, has been a complete success from the standpoint of the employee and apparently from the standpoint of the management.

"A vital factor to any organization is cooperation and in order to get results the men must be satisfied. Before making the move from 12 to 8 hours, a carefully worked out plan was laid before the men by the management, showing how the 8-hr. day could be arranged and the wages maintained, so the men could earn nearly as much in an 8-hr. day, as they had by working the longer hours.

"The change was made without a hitch and while the force was reduced, it was done in such a way that no hardship was caused and the men were satisfied.

"Since the plan was placed in operation nearly three months ago, there has been a decided change for the better in the spirit of the men. There is little trouble with men laying off and we have no trouble in getting a man to fill in on the open-hearth floor. The tonnage has been increased on all furnaces in operation and some of the furnaces have broken all previous records.

"When tapping heats on the floor, the first and second helpers go from one furnace to another and assist each other. Every man is experienced and the bottom making is done in 50 per cent of the time and with a saving of material. The bottom trouble has also been cut down to a great extent, for with new men coming on each eight hours, there is a desire to accomplish all they can during the time they are in the shop.

"To the single man, or the man with a home and family, the 8-hr. day gives a chance for recreation and enjoyments of the comforts of home and family, which in turn reflects back in the increased vigor and energy with which he goes about his work.

"I have walked along the floor and talked with nearly all of the men and did not find one man who would care to go back on the old routine of 12 hr. a day. They will tell you that they feel better in mind and body and are satisfied, both with working conditions and the rate of pay. In return they are willing to cooperate, in any way, with the management in anything they desire to carry out.

"A great deal of credit for the success and benefits derived from the 8-hr. day should be given to our open-hearth superintendent, Mr. Harrison, who keeps in personal contact with all of his men and who is ever ready to listen to any suggestions that will help better conditions for the men and make the open-hearth at the Donner Steel Co. a desirable place to work."

### Recognizing the Human Element

The second is an article submitted by a representative of the men in the open-hearth stock house.

"A few weeks prior to Aug. 21, 1923, the date of the change from 12 to 8 hr., a general meeting of employees and executives was called and the anticipated change freely discussed, committees appointed, etc. Subsequent meetings brought forth the unanimous expression that the change should be given a trial and then the question of wages arose, the men wondering whether or not the change could be made without impairing their earnings, as in effect with the long shifts.

"A suggestion, which had its source at one of the committee meetings, was then put to them, said suggestion being that the two 12-hr. shifts be divided into three shifts of 8 hr. each. This suggestion, too, was unanimously carried, the men agreeing to put forth additional efforts to overcome the apparent loss of labor involved in the change, which of necessity made the question of pay a negligible quantity, their opinion being that fewer good men at a high rate of pay could maintain as efficient a working organization as more men at a lesser rate.

"The change was made on Aug. 21, 1923, and, it must be emphatically stated that this change, considering its magnitude and the vital bearing it had on the steel industry in general, went over in one day without a hitch and without a dissenter in the organization, which, to our mind, is a wonderful achievement, for both the management and the men.

"Since the inauguration of the 8-hr. shift, which is now a permanent institution, the following beneficial results may be summarized:

1. *Increased efficiency and production.*
2. *Absolute contentment of employees.*
3. *Elimination of "slackers."*
4. *Labor turnover practically nil.*
5. *Regular attendance at work.*

"This gigantic and successful move was made possible only by the recognition of the essential human element, in that the management and the men met on common ground, discussed the situation pro and con, and recognized that one element was as necessary as the other in the fulfillment of the change."

### Satisfied in the South

BIRMINGHAM, ALA., Dec. 31.—Elimination of the 12-hr. day is being tried out, or rather being put into execution, only by the United States Steel Corporation

subsidiaries in this district, and the try-out has not been of sufficient duration to determine fully its effect. The need of more labor was estimated before the introduction of the plan was started. Fortunately, activity was not as great in varied industries as in the past, and it was possible to shift some of the men to those departments where the elimination of the 12-hr. day was in process of execution. In order to reduce the working time and to prevent too great a difference in earnings, it became necessary to adjust some of the wages. In the Birmingham district there is a better feeling between employee and employer than in other districts, and there was no demand for the certain number of hours or that wages should be so readjusted that for the lesser hours there should be the same pay. In accomplishing the elimination of the 12-hr. day, 8 hr. was not instituted in all departments. There are still many men working 9 and 10 hr. There has been no change in the class of labor seeking employment in this district.

Apparently no effort is being made in this district to organize the iron and steel workers.

No information emanates from other companies other than the Steel Corporation as to any change in the hours heretofore worked. In some departments of the steel mills there has been cause for curtailment in numbers employed, but the skilled labor has been protected as much as possible, for the need of the labor will be at hand before long.

It is difficult to get statements as to why the elimination of the 12-hr. day is not being put into execution generally. That the move adds to the cost of production is stated. As a rule labor affected by the elimination of the 12-hr. day in the Birmingham district appears willing to accept what is given, but there is some mumbling about loss of earnings.

A survey, as accurate as possible in short time, would place this district, where the elimination of the 12-hr. day has been undertaken on a basis of about 35 per cent on 8 hr. and 65 per cent on 9 and 10 hr., so far as pig iron and steel are concerned. Where elimination of the long day has not been attempted, about 25 per cent of the labor (iron and steel) is on 8 hr., 50 per cent on 9 and 10 hr. and 25 on 12 hours.

## Satisfactory Results in Southern Ohio and Kentucky

CINCINNATI, Dec. 31.—The year 1923 closed with practically all units of the iron and steel industry located in the southern Ohio and northern Kentucky district working under the three-shift plan where continuous operations are conducted.

There had been no real demand from the workers for the 8-hr. day at merchant furnaces, as they felt that with the intermittent operation of these furnaces it was necessary to get in as much time as possible when the furnaces were in blast, particularly in those sections where other employment was not easily available. But it was felt, both by management and workers, that if such a thing were possible an 8-hr. day would prove advantageous in many ways to both employer and employed.

The first merchant furnaces to go on the shorter time were the silvery furnaces in Jackson County, and the furnace of the Marting Iron & Steel Co. at Ironton. The 8-hr. day was instituted at these furnaces on Aug. 23, and the results have proven the wisdom of the move. While it was felt that an increased number of men would be required to operate the furnaces, the extra number put on ranges, in one case, from none up to four at one furnace.

On Sept. 1, the blast furnace department of the Whitaker-Glessner works of the Wheeling Steel Corporation was put on the three-shift plan. Belfont furnace, on starting up late in November also put on three shifts, and on Dec. 1, the Ashland blast furnace department of the American Rolling Mill Co. changed over. The Columbus works will go on the shorter day the first of January. Other furnaces, not now in blast, have made arrangements to operate on the three-shift plan when operations are resumed, so that the district is practically a unit in adopting the shorter working day. The coke oven plant of the Portsmouth By-Product Coke Co. is also operating under a three-shift plan, and other coke plants will operate under the same conditions in the immediate future.

Where operations are not continuous, some workmen still are employed nine and 10 hours a day, but it is a conservative estimate to say that the number of men working eight hours in the southern Ohio and northern Kentucky district averages 80 per cent of the total.

The question of efficiency has been settled satisfactorily. According to operators of furnaces, the men are working more efficiently than ever before, perhaps the best illustration of this being the fact that practically all the furnaces which have instituted the 8-hr. day have, since putting it into effect, broken all previous records for output.

## Only a Few in Cleveland Have Not Changed

CLEVELAND, Dec. 31.—The 8-hr. day is now in full operation in most of the steel plants and blast furnaces in the Cleveland territory. The American Steel & Wire Co. was the first to adopt the three-shift plan with a 25 per cent increase in the hourly wage rate in its open-hearth, blast furnace and coke oven departments where there are continuous operations. This was followed by a reduction of from 12 to 10 hr. in some of the other departments where operations are not continuous and with an increase of 10 per cent or equivalent to 11-hr. pay for 10-hr. work. This company has now entirely eliminated the 12-hr. day in its operating department. Its wire mills are operating partly on a 10-hr. and partly on an 8-hr. schedule. Approximately 70 per cent of the employees of the company in its operating departments are on a 10-hr. day and 30 per cent on an 8-hr. day.

The McKinney Steel Co. followed the Steel Corporation in its adoption of the 8-hr. day in its Cleveland blast furnaces, steel plant and coke ovens, placing all of the departments in which operations are continuous on the 8-hr. day. The United Alloy Steel Corporation, Canton, Ohio, adopted the 8-hr. day Nov. 1, in the open-hearth department and followed with the blooming mill, bar mill and blast furnace divisions as soon as the proper studies could be completed. General Manager Charls states that these divisions are now operating on the three-shift system satisfactorily. The Trumbull-Cliffs Furnace Co., Warren, Ohio, inaugurated the 8-hr. day Sept. 8 and had it in full operation in its blast furnaces early in October. The Trumbull Steel Co., Warren, has long operated on the 8-hr. schedule as has the Upson steel plant of the Bourne-Fuller Co., Cleveland. The Central Steel Co., Massillon, Ohio, has been operating its steel plant on an 8-hr. schedule since 1921. The plant of the Cleveland Steel Co., Cleveland, has also operated for a long time on the 8-hr. basis. The Otis Steel Co., Cleveland, has not yet inaugurated the shorter day in either its blast furnaces or open-hearth departments at the Riverside works, but is preparing data on the subject with the view of adopting the shorter working day. The company expects to open its steel plant at its Riverside works in January, and may put the 8-hr. day in effect there. The men in the Lakeside plant were on an 8-hr. and 9-hr. day before the general adoption of shorter hours in the country last summer. The men in the steel foundry are working 8 hours.

The merchant blast furnaces placed on the 8-hr. day include the Toledo furnaces at Toledo, Ohio, and the Perry furnace, Erie, Pa., of Pickands, Mather &

Co., the Detroit and Cherry Valley furnaces of the Hanna Furnace Co. and the Sharon, Pa. furnace of the Stewart Iron Co. The Hanna Furnace Co. had prepared to inaugurate the short day at its Dover furnace, Dover, Ohio, but the carrying out of the plan was delayed by the blowing out of this furnace. The 12-hr. day still remains in effect in the Hanna company's Buffalo furnaces. The McKinney Steel Co. has not placed the short day in effect at its Josephine and Scottdale furnaces in Pennsylvania and its Genesee furnace in New York. These furnaces are located in small places where it does not take the men long to go to and from their work and it is stated that the employees at these furnaces are generally opposed to a reduction in their hours.

That they are well satisfied with the change to the shorter hours is the consensus of opinion of heads of steel plants and blast furnaces. The basis for this sentiment seems to be in the unanimous expression that the short hour day has created a better feeling among the men and that they are more contented than when they were working the longer hours. At the start there was considerable difference of opinion among the men over the short hour day. Many objected to the reduced hours because of decreased earnings. However, it is the opinion of operating heads of both steel plants and blast furnaces that this feeling has almost wholly disappeared. While there are still a few foreign laborers who still prefer to work 12 hours, it is claimed that a large majority would object to the restoration of the 12-hr. day with the increase of earnings.

Coming as it did during the slowing down of activity in many lines, the adoption of the shorter day did not create any labor shortage as plenty of surplus labor was available to supply the additional needs of the iron and steel industry. From the standpoint of quality, it is the general opinion that the shorter hours have not brought a better class of workers to the steel plants and blast furnaces.

### Labor More Efficient

That labor has become more efficient since the adoption of the 8-hr. day is the general opinion of managers of steel plants. The operating head of several plants, commenting on this increased efficiency, declared that he could not tell whether the shorter hours had anything to do with it or whether the increased efficiency was due only to the abundant supply of labor, and that it would take considerable time to decide that question. "Where there are men at the gates looking for jobs, those inside are always much more efficient," he said. In this company's plants, work is being rearranged so that loafing periods are being eliminated and the general efficiency of the plants is being improved.

### Men Are Satisfied

One of the Central Western pig iron producers operating several furnaces finds that its men are well satisfied with the shorter day and would object to a restoration of the 12-hr. day although some were opposed to the change when it was made. The shorter day has not resulted in any noticeable improvement in the character of applicants for work, although it has brought back some old employees who quit two or three years ago and these have been re-hired provided their previous records were good. The shorter day has resulted in some improvement in labor efficiency in this company's blast furnaces. The company is paying considerable attention to the economics of the situation and has succeeded in making some reductions in labor costs. It has not yet been able to complete definite data on comparative costs, but according to its present estimates its saving on labor is not sufficient to compensate for the reduced costs and higher wages. This saving of labor has resulted largely from rearranging and distributing work so that the men are kept busy continuously. Under the 12-hr. day, men in the cast house were idle a large part of the time between casts after cleaning up and from custom they had come to feel that they had the right to loaf during these periods of an hour or more. At these furnaces labor has also been saved by reducing the number of men in a crew. When there were six men in a crew, the change, without reducing the size of the crew, made an increase of from 12 to 18 men for the three shifts, but in some cases the crew has been reduced to five men, making 15 for the three shifts. In one case, one man is doing work formerly done by two, so that instead of having four men on two shifts, two on each 12-hr. shift, the work is being done by three men, one on each 8-hr. shift. While some work such as operating scale cars, hoisting engines, etc., does not permit a saving in labor, as an operator must be on hand all the time, this company has been able to reduce locomotive crane work from two 12-hr. to two 10-hr. shifts by speeding up the cranes during the shorter work day.

### Difficult to Reduce Number of Men

Another blast furnace plant which has no cast house, the hot metal being used in the open hearths or going to the pig casting machine, has found little opportunity to reduce the number of men working on a turn, as the work is done by crews having regular operations that require a certain number of men. In some cases 8-hr. men in blast furnaces are staying on the job for two shifts or 16 hours. However, at the Ford furnaces in Detroit there is a 48-hr. week in effect, so that if a man should work two turns in succession, he would have to lay off some other time during the week to keep the total time he works down to 48 hours.

### Increased Cost of Production

The 8-hr. day has not been in effect long enough to determine definitely the increased cost of production at blast furnaces, but some operating heads figure that under normal conditions this will amount to from 10 to 15 per cent. However, data tabulated by an Ohio merchant furnace show that under the 8-hr. day its payroll increased during one month only 4.8 per cent. The increase in cast house charging and stove labor was 1.5 per cent, boiler house labor increased 2.4 per cent, yard switching labor 5.6 per cent and casting machine labor 14 per cent. In this plant, where it has been possible, 12-hr. shifts have been replaced by two 10-hr. shifts instead of three 8-hr. shifts, the 10-hr. day applying to such work as yard labor and locomotive crane operations. The regular 25 per cent advance was granted to the men put on 8 hours and the hourly rate of the 10-hr. men was increased from 5 to 10 per cent. The total number of employees has been increased from 165 to about 190. The production cost record was made when there was an abundant supply of labor. When the surplus of labor disappears and a scarcity develops with probable lower efficiency, the costs are expected to increase considerably.

## Some Eastern Pennsylvania Plants Have Not Adopted Shorter Day

PHILADELPHIA, Dec. 31.—The smaller independent steel companies in eastern Pennsylvania have not adopted the 8-hr. day, nor have they intention of doing so until the results of the introduction of the shorter day in the mills of the United States Steel Corporation and the larger independents have been fully determined. Some of these Eastern mills have had experience with the shorter day and it did not prove satisfactory either to the men or to the companies. One company which makes plates was requested by its men to restore the 12-hr. day after a trial with a shorter day, the greatest pressure being brought to bear upon the plant management by the wives of the workmen. The protest of the women had a somewhat humorous side in that their chief objection to the shorter day was that it gave their men too much time for "loafing" at home and on the streets. It is stated by executives of some of the smaller Eastern companies that there has been no urging on the part of the men for any change in their present working hours. Hence the companies are disposed to await further developments in the present experiment.

# What 1924 Promises for American Business

## The Large Volume of New Construction a Chief Guaranty of Activity in the Coming Year—The Check to Expansion Last Spring Helped to Prolong Good Times

BY GEORGE E. ROBERTS

SENTIMENT in business circles has been improving since October and the outlook for 1924 is considered good. The feeling is that the check in industrial expansion which occurred in the late spring has steadied progress and prolonged good times rather than otherwise.

This change in industrial confidence has come about as a result of a number of new and noteworthy economic trends and events. In the first place, the declaration of increased or extra dividends by a number of large corporations has been regarded not only as evidence of the past year's earnings of these concerns but of a definite feeling of security on the part of prominent directors of these companies as to the future in their respective industries. A satisfactory volume of business in 1924 is expected, with profits reasonably good. Secondly, reports from trade circles have spoken significantly of increasing activity in several basic lines. Thirdly, President Coolidge's message to Congress and his message presenting the budget have won a response from the press that suggests a willingness on the part of the public to follow his economic leadership. Secretary Mellon's plan of tax reduction has commanded emphatic public approval, and its adoption would result in a new impetus to industry and business in all lines. The country is in need of just such an impetus at this time. And finally, the credit situation is eminently satisfactory, giving assurance of ample funds to carry on business upon the present level.

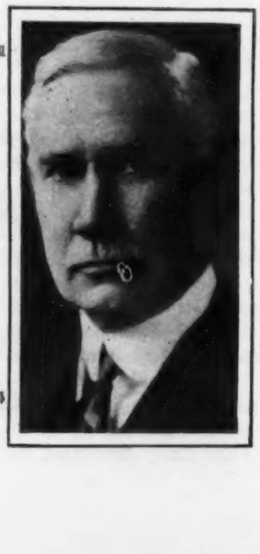
### Unsatisfactory Features

While these are the recent and constructive developments in the situation, its weaknesses must not be overlooked. Good times today constitute a spotty prosperity. The bulk of the most profitable and active business is centered around the building industry, the automobile industry, the railroad equipment industry, the iron and steel trades and the auxiliaries of each. On the other hand, leather, tires and rubber, coal, chemicals, oil, copper, agriculture, farm equipment, have been discouragingly sluggish. It is to be hoped that the new year will see a gradual reallotment of the existing prosperity on a more equitable basis. The recent improvement in oil suggests that the trend is in that direction. The pace, however, has been and will be slow; but it is obvious that the quality of good times is measured by the length, breadth and inclusiveness of the prevailing prosperity, and not by its intensity in any one spot. So a more profitable business is necessary in more of the sluggish lines, and these must include agriculture.

Unfortunately of late the tendency has been to reaction in the prices of certain farm staples. Wheat has slumped, largely as the result of developments indicating world supplies probably in excess of estimated requirements. Since Nov. 1 No. 2 corn has declined more than 15 cents. This has been due to the weight of new crop offerings in primary centers. Heavy receipts have depressed cattle and hog prices, the latter being about $1.25 per hundredweight under those of a year ago. This situation is the more disquieting to the farmer because of the rising prices of the commodities he must buy in the open market. Nor is this uneasiness confined to agriculture. An inequitable relationship exists between the purchasing power of the products of such industries as dyes, chemicals, tires, rubber, leather, paper, copper and farm equipment, and that of the products of other and more fortunate industries. The lack of balance is at once perceptible in a yearly or monthly comparison of the range between the maximum price and the minimum price attained by any one of the nine commodity groups reported by the Bureau of Labor. This spread for the averaged months of 1914 was 18 points. In 1915 it had increased to 46, and by 1920 it had been more than doubled, reaching 103 points. During 1923 the trend was toward equalization. In January the spread was 94 points, and by October it had been reduced to 79.

Conditions in these lagging industries have been made worse by the announcements of wage increases for railroad employees and others, many of whose incomes have already increased out of proportion to the enlargement of the incomes of other classes of the community. The greater portion of the country's purchasing power, as far as individuals are concerned, rests with organized labor and the owners of the more fortunate and prosperous industrial enterprises. The comparatively light incomes of the salaried man, the own-

*AS editor of the Monthly Letter of the National City Bank of New York, of which he is vice-president, Mr. Roberts has made contributions of the highest value to the literature of economic development since the war. His comments on the business situation in the United States and his analysis of the forces which have been most determining in these difficult years have had wide acceptance for their accuracy, clarity and sound reasoning. As editor and supervising director of the American Chamber of Economics, Mr. Roberts prepared the text for that organization's reading course, known as "Economics for Executives."*

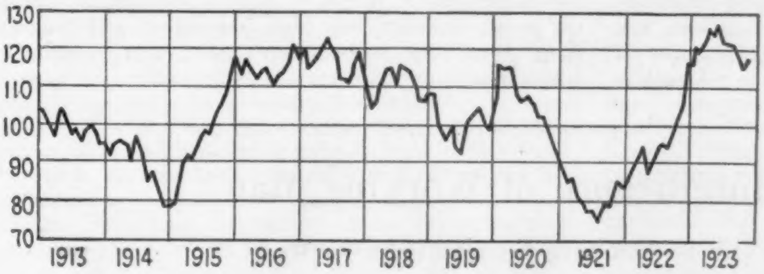


ers of less fortunate businesses, and the farmer need give little concern about the volume of trade in consumptive goods as long as employment is heavy. It is clear, however, that such purchasing ability, suffering under such discrimination, will manifest itself cautiously and timidly and that it will not support a pronounced revival in commodity prices.

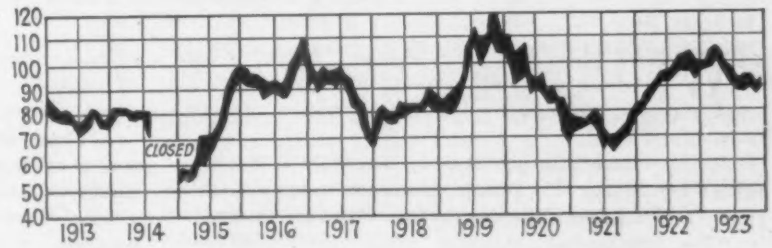
General prosperity is the result of balanced relations throughout industry. A perfect balance never is attained, for conditions affecting supply and demand are always changing; but the free play of economic forces is always tending to restore the equilibrium, while Government regulation almost inevitably interferes with the operation of the natural forces.

**Basic Industries Active**

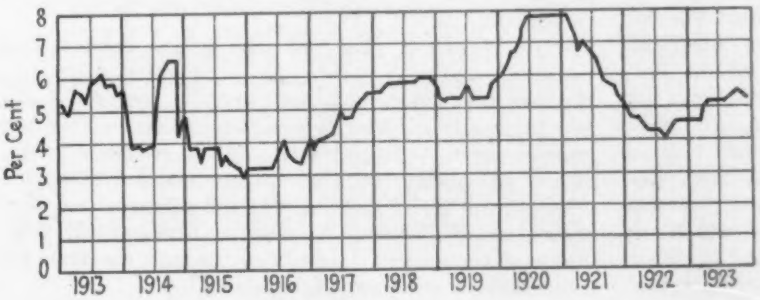
The one basic industry which holds out the greatest hope for 1924 is that of building and construction.




Index of Production in Basic Industries. Source: Federal Reserve Board. Year 1919=100




Price Fluctuations of Twenty Industrial Stocks. Source: *Wall Street Journal*




Discount Rate of Commercial Paper. Source: *Wall Street Journal*

Nineteen twenty-three was a record building year. A mild, open December, a desire on the part of 1924 builders to begin early and take advantage of the slight recession in building material costs, and the remaining deficit in new building all explain the present unusual activity. The new year may not attain the high record of 1923, but the industry will be active for most of the twelve months, because work on the large volume of contracts awarded in the early winter will be done for the most part in 1924. The requirements of new construction are drawn from such a vast number of trades that the amount of such work more than any other single factor will determine the general state of business in 1924.

Another good symptom for the new year has been the revival in the demand for pig iron which began in November. This has been caused by foundries preparing for manufacturing activities. Seasonal influences have not favored a strong movement within the industry, for December is an inventory-taking month. More activity is expected after the first of the year. The demand for steel has been similarly gratifying, with the buying for future delivery increasing in volume. The heaviest purchases are reported to have come from the large automobile manufacturers, but the railroads have also been prominent. Structural awards have not only sustained their large volume, but the amount of new business offered is increasing.

The automobile industry has had an exceptional year. The total production of cars and trucks for the first 11 months of 1923 has been more than 50 per cent in excess of last year. Output is now running seasonably light, but monthly totals are still breaking records. The outlook for 1924 favors a continuance of heavy production for the first half of the year at least.

Railroad equipment manufacturers have not relinquished their prominent place as heavy purchasers in the steel markets, but the railroads have reconditioned or replaced a greater part of their equipment, and new and unfilled orders are declining. The carriers' programs of development, however, will extend well into 1924, stimulating spring buying and maintaining the industry's activity well above normal for the greater part of the year.

Production in basic industries, as reported by the Federal Reserve Board, increased approximately 3 per cent in October. Only slight changes are expected to be shown for November and December, for this figure is corrected for seasonal variation and increases in some industries have offset to a large extent declines in others. Prevailing optimism, increasing speculation and a declining money market all suggest that production will run better than normal during the earlier months of 1924.

In cotton textiles new business dilly-dallies, and seems reluctant to assert itself. The rising price of raw cotton has demoralized the goods industry and production is slowing down in some quarters and increasing in others. Curtailment at Fall River is reported to have reached 50 per cent. Retailers have been able thus far to satisfy requirements from stocks made up at lower costs, and not until these stocks are

exhausted will the effects of present costs upon consumption be known.

**Prices, Costs and Money**

The curve of commodity prices, during the coming six months, is not likely to depart far from the horizontal, with the trend, if any is discernible, slightly upward. Buoyant markets probably will not be encouraged by the placing of heavy forward commitments, for purchasers, with a view to keeping inventories liquid and low, will adopt the policy of buying to cover only immediate needs; and any notable advance in prices would be apt to encounter some manifestations of consumers' resistance. Further and heavy declines in quotations, on the other hand, will be opposed by high and inelastic costs and by the prevalence of relatively easy money.

Employment is full with the tendency favoring a slight reduction. It is entirely probable that this movement is almost wholly seasonal, for in many industries December and January are dull months. Wages are high, and announcements of increases exceed those of cuts. A recession in labor costs is not in immediate prospect, and further increases are likely if the spring expansion in industry is similar to that of 1923, or if rising prices force living costs too acutely upward.

Due to early liquidation in agricultural centers and a lessened industrial demand for funds, interest rates have begun their decline earlier than usual. Commercial paper rates have dropped from 5 per cent for prime paper and 5¼ per cent for the lesser known names to a range of 4¾ to 5 per cent respectively. After the new year further weakness may be expected. An indication of the supply of funds seeking employment is the heavy oversubscription of the Treasury's offering of $300,000,000 certificates of indebtedness on Dec. 10. Brokers' loans are reported as $1,335,000,000, compared with $1,325,000,000 on October 29, the low point of the past year. Investment demand for funds is increasing moderately, and the volume of securities issued to obtain new capital is likely to be large in the opening months of 1924. The bond market, in which the movement of prices is usually counter to that in the money market, has been improving, and transactions have been increasingly heavy and covering a wider area.

# Tribute to Intelligence of Working Man

## Harvester Company Official Declares Fundamental Views of Men Toward Economics of Business Are Sound

"WHAT steps has your company taken to combat false economic propaganda and to give its employees the truth regarding the conduct of its business affairs?"

When asked this question by an IRON AGE representative, Arthur H. Young, manager industrial relations, International Harvester Co., Chicago, replied:

"The intelligence, common sense and innate conservatism of the American worker has been greatly underestimated. We have heard much about the insidious dissemination of radicalism among American workmen, particularly since the inception of the Bolshevistic experiment in Russia, but apprehension on this score has emanated largely from those who have their eyes fastened on Europe.

"It is not infrequently urged that the time has come to rise to the defense of the capitalistic system and to stamp out false and dangerous ideas which are finding fertile soil in the dense ignorance of labor regarding economic problems. Ignorance of the actual viewpoint of the workmen, however, is far more extensive than the latter's ignorance of sound business principles. In other words, management has much to learn about its employees before it sets out to educate them. In fact, the International Harvester Co. places the highest value upon its works council plan, because this has given the management intimate contact with the employees, affording a clear insight into what is actually going on in the minds of the men.

"The works council plan, which has been in effect for nearly five years, has proved successful because it was built on faith in the intelligence of the men, rather than on the theory that they were ignorant. It gives council representatives a voice in deciding controversial points such as wages, hours and working conditions—matters which are of vital importance in the conduct of any business. If employee and management representatives in any council fail to agree on a given issue, the question is referred to the president of the company and, if he cannot propose a settlement satisfactory to both sides, they may mutually agree to arbitration. At the same time, they are at liberty to refuse to arbitrate, if they choose. If the issue affects other plants, the president has the privilege of calling a general council of representatives of all plant councils to consider the question de novo.

"The employees have been given real responsibility and they have lived up to it. In deciding questions of policy in conjunction with the management, they have shown eminent fairness and a comprehension of sound economic principles which would do credit to many of those who are loudest in their excoriations of radicalism.

"The spirit of give and take in the councils has promoted mutual respect. The employees appreciate the fact that their views are carefully considered and are frequently adopted as company policies. They are likewise anxious to give a ready ear to the management's conceptions of a given problem and to lend a willing hand to its solution. If the company has succeeded in enlightening its men on fundamental principles of economics, it has been through the frankest discussion of the company's affairs.

"For example, the annual statement is explained to the councils by the controller and the treasurer in person. They analyze the combined balance sheet and clarify any points concerning which questions may be raised. Every councilman is furnished a copy of the statement and you may rest assured that it gets an intelligent reading. The surplus of the company as shown in the last statement was over $52,000,000. There is no misconception on the part of the councilman as to the significance of this figure. Surplus to him does not mean so much hard cash in the vaults of the treasury which, distributed, would make the employees rich. He not only knows that the surplus is not necessarily in the form of cash, but he is well aware that the annual payroll of the company has exceeded $90,000,000 per annum, or not far from twice the surplus.

"Through the works councils, the company has taken its employees into its confidence. It has given them participation in the shaping of company policies. The workmen have justified the confidence placed in them and they have no illusions as to the proper conduct of the business."

# Exports as a Percentage of Production

**Iron and Steel Products Shipped Abroad Form a Varying but Small Percentage of the Country's Output—History of the Past 14 Years**

IN considering the relation between production of rolled iron and steel, both finished and semi-finished, and the quantity of this material which finds its way into foreign markets, many angles present themselves. In the first place, the time interval between the pouring of a ladle of steel into the ingot mold and the clearance of a ship from an American port, with her cargo made up in part of what went into that ingot, is a nebulous quantity. Probably during the stress of war times this interval was short, although traffic delays may have tended somewhat to equalize that period with those before and after. At present, however, it is by no means certain that an ingot poured today finds its way into a seagoing bottom within the next month.

It has long been argued by those interested that foreign trade should be an everyday part of the program of American iron and steel makers—that it should not be regarded merely as an outlet for surplus material which can not be marketed at home. Those who have taken this view have counselled an intensive cultivation of foreign markets, extensive credits, both as to amount and as to time, and unremitting vigor in pursuing the foreign buyer.

Unfortunately we have to consider such questions as the ability of the foreign buyer to finance a purchase. Just now the great bulk of our largest market for general goods, and itself a sizable market for iron and steel, is in such a bad way, politically, financially and industrially, that adequately secure and prompt credits are almost impossible to arrange. Similarly, in other quarters where credit stringency is less a factor, the question of month to month and year to year buying power is nevertheless of prime importance, in connection with the shipment of iron and steel manufactures from our ports.

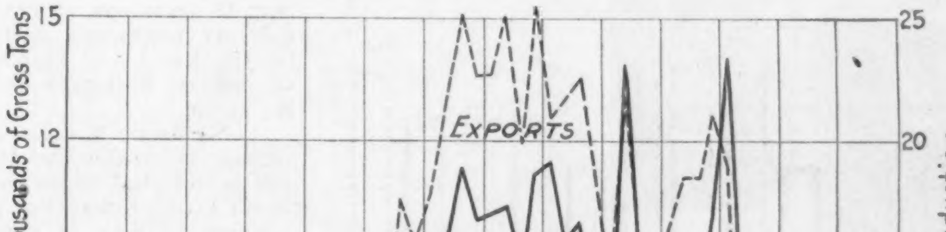
Another more or less nebulous quantity lies in the semi-finished field. It has long been the practice of the American Iron and Steel Institute, which gathers statistics of rolled products and periodically makes them public, to ignore the production of semi-finished products, except for those which are produced for export. This policy is thoroughly well founded, because any other treatment, other than a complete elimination of the semi-finished tonnage, would result in duplication of figures. Consequently, in the annual reports of that institute we have, as the total rolled iron and steel item, the sum of finished products and the export tonnage of billets, sheet bars, wire rods, etc.

Another element of uncertainly lies in the proportion of wrought iron covered in the figure of rolled products. Manifestly it is small—rarely, now, over 4 per cent—but it certainly varies from year to year and, to anyone attempting, from ingot production figures, a precise determination of the percentage of materials exported, this might introduce a disturbing factor.

With all the above considerations in mind, an analysis of the situation of our export tonnage and its relation to the production tonnage has been made. Monthly figures of production have been built up from the monthly ingot figures on the assumption that the percentage relation of the year, between ingots and rolled product, was maintained month by month throughout that year. While this assumption is not strictly accurate, it nevertheless errs about equally on both sides of the exact percentage, as the history of the year develops. In working out this percentage, the wrought iron is necessarily included, under the limitations mentioned above.

Quarterly figures are used. It is believed that by this means practically all of the uncertainty regarding the time element has been made to disappear. Whatever tonnage is shipped abroad in any quarter in which it is not produced may be assumed to be minor in quantity and to balance up, quarter by quarter, as they occur. This method does away with the excessive fluctuations shown by the records of single months and smooths out the curve generally, while giving a truer picture of the situation from the statistical standpoint.

Estimates have had to be made for the ingot ton-




Plotted Quarterly, the Rolled Iron and Steel Export Figures During the Past 14 Years Have Ranged From 300,000 Tons to More Than 1,500,000, and the Percentage, Based on Our Production, From 4 to 23 or More. Disregarding the artificial stimulus of the war years, 10 per cent appears "normal," but recent exports have hovered around half that amount

nage of the period preceding June, 1917. This has been done on the basis of calculations in which it was assumed that the daily production of ingots, in the working days of each month, was proportional to the daily production of pig iron as recorded in that month. Here again exactitude is not claimed, but the figure cannot be far wrong; and such errors as exist tend to cancel each other as the year progresses. Such a calculation, covering the period from June, 1917, to June, 1922, and with particular reference to filling the gap in the fall of 1919 when the steel strike stopped the reporting of ingot tonnages, will be found on page 71 of THE IRON AGE, July 13, 1922.

For the year 1923 the ingot tonnages, reported monthly by the American Iron and Steel Institute, cover so large a proportion of the industry that the estimate for the missing 5 per cent of capacity gives us a total which must be accurate within a small fraction of 1 per cent. Here, again, a further estimate has to be made, however, to obtain rolled tonnage figures from the ingot production. This has been put at 77 per cent, which is not far from the recorded ratio for the calendar year 1922. As a basis for obtaining an export ratio, this tion tonnage estimate, at least until we have the final gives what must be regarded as a satisfactory produc- figures of the year, some time next summer.

*United States Production and Export Movement of Rolled Iron and Steel, in Thousands of Gross Tons*

| | Production | Exports | Per Cent |
|---|---|---|---|
| 1910 | 21,621 | 1,319 | 6.1 |
| 1911 | 19,039 | 1,908 | 10.0 |
| 1912 | 24,657 | 2,474 | 10.0 |
| 1913 | 24,791 | 2,238 | 9.0 |
| 1914 | 18,370 | 1,318 | 7.2 |
| 1915 | 24,393 | 3,168 | 13.0 |
| 1916 | 32,380 | 5,208 | 16.1 |
| 1917 | 33,068 | 5,582 | 16.9 |
| 1918 | 31,156 | 5,006 | 16.1 |
| 1919 | 25,102 | 3,856 | 15.4 |
| 1920 | 32,348 | 4,452 | 13.8 |
| 1921 | 14,776 | 2,099 | 14.2 |
| 1922 | 26,452 | 1,830 | 6.9 |
| 1923 ( 9 months) | 25,966 | 1,354 | 5.2 |
| 1911-12-13 (3 years) | 68,487 | 6,619 | 9.67 |
| 1914-15 (2 years) | 42,763 | 4,486 | 10.49 |
| 1916-17-18 (3 years) | 96,604 | 15,796 | 16.35 |
| 1919-20-21• (2½ years) | 65,358 | 9,831 | 15.04 |
| 1921°-22-23† (2¼ years) | 59,285 | 3,760 | 6.34 |
| 1910 to 1923† (13¾ years) | 354,119 | 41,812 | 11.81 |
| Same total, omitting 1915 to 1918 | 233,122 | 22,848 | 9.80 |

•To July 1.
°From July 1.
†To October 1.

### What the Curves Show

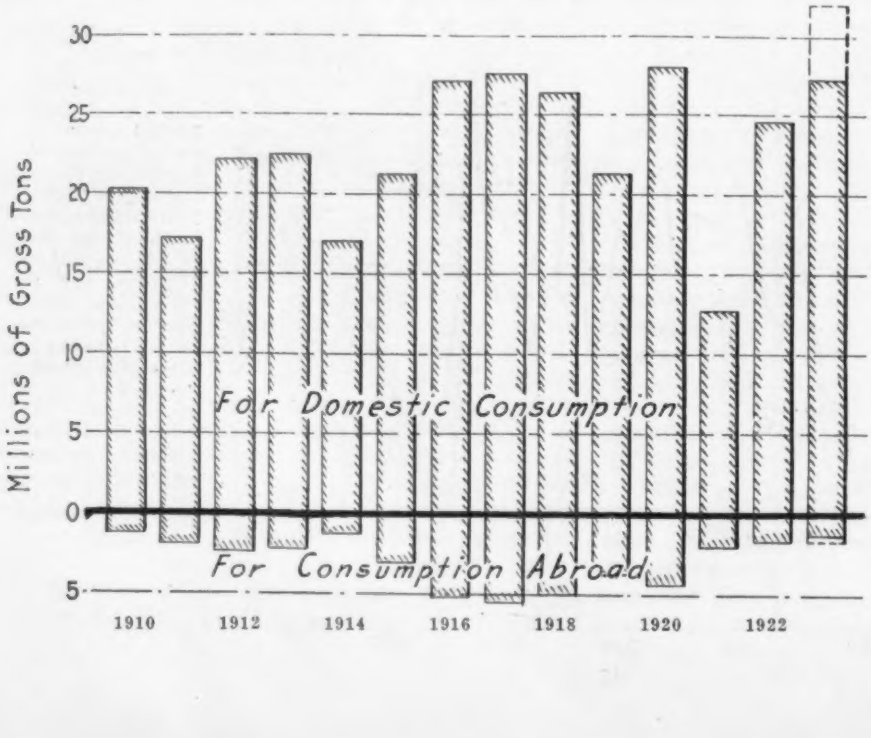
It is evident from the curves that we may divide the 14-year period into a succession of epochs, each having characteristics somewhat different from the others. Omitting 1910, which was a year of recovery from the depression of 1908, we have a three-year period, 1911 to 1913 inclusive, in which exports represented 9.67 per cent of production. Taking the years 1914 and 1915 together—emerging from the doldrums of the former and getting into the beginning of the European war orders—we have two years showing an average of 10.49 per cent of production going into exports. Then come the three big war years, 1916 to 1918 inclusive, with exports 16.35 per cent of production.

Following this is a period of 30 months, 1919 and 1920 and the first half of 1921, with exports almost as high in proportion to production as in the big war years, but this proportion was formed not so much because of heaviness of exports as because production fell off markedly. For 2¼ years, beginning in the middle of 1921 and bringing the history up to date, we have reached the lowest of all these export percentages, with 6.34 per cent. This is close to the 6.1 per cent of the year 1910, which we omitted above. And 1923, with but 5.2 per cent, is lowest of all. The tremendous production of this year—very close to the record year of 1917—has gone mostly into domestic consumption, shoving that figure above 30,000,000 tons for the first time.

Taking the entire period of the diagram—13 years and 9 months—we find production, as shown in the table, to have been 354,118,600 tons of rolled iron and steel, while exports amounted to 41,812,000 tons, or 11.81 per cent of the production. Omitting the four years, 1915 to 1918 inclusive, with the big war needs of Europe, we find production at 233,121,800 tons and exports at 22,847,600 tons, or 9.8 per cent of production. Evidently, therefore, a normal export percentage based on the peace time record of the past decade or more is not far from 10. As a matter of fact, the years 1911 and 1912 showed almost precisely 10 per cent each, while the 4¾ years, since the beginning of 1919, have provided not quite 11 per cent. The three big years during the war showed remarkable uniformity, being in each case between 16 and 17 per cent —much of this being in the shape of semi-finished steel for the production of shells and other war material.

Comparing the present situation with that of the pre-war years, it is clear that we are considerably below the export percentage of those years and below the actual tonnage of some of them. The years 1911, 1912 and 1913 all showed a higher export tonnage than did 1922, and higher than 1923 on the basis of the first nine months. This, of course, is something which is not inherent in the American iron and steel industry. It reflects lack of purchasing power on the part of erstwhile customers, due in large measure to depreciated exchange and to unemployment, political disturbances, and the withdrawal of large bodies of men into military service. Even though these military bodies be no larger than 10 years ago, they form a larger percentage, particularly in the case of France, of the depleted working power of the nation.

Consequently it is scarcely rational to suppose that there will be material improvement in our export tonnages or percentages so long as present unsettled conditions prevail abroad. Economic health on the part of our prospective customers will be a necessary prerequisite for resumption of trade on a large scale.




In 1923 Our Production of Rolled Iron and Steel for Domestic Consumption Makes a New High Record (the Dotted Line Covering Estimates for the Last Two Months)

# Structures of Gray Iron and Semi-Steel

## Their Study More Essential Than Formerly—Cementite and Steadite—Science Necessary in Molding

BY J. W. BOLTON*

ADVANCES in design of machines often demand better materials for their practical development. Conversely, the creation of stronger, or less corrodible, or better cutting metals, often suggests designs not before attempted because of the limitations of the heretofore-used materials.

Today there is a demand for better gray iron castings, the so-called semi-steels and high-test irons. In the machine tool industry for example, the trend is toward heavier duty machines. The use of alloy steels and bronzes is now standard for many parts. For some parts steel castings have supplanted those of gray iron, yet the bulk of the machine must be made of gray iron. Where strength and wear are important factors, the higher grade irons give best service. Because of this, some manufacturers, not content with the old weaker irons, are using the best high-test metal wherever practicable.

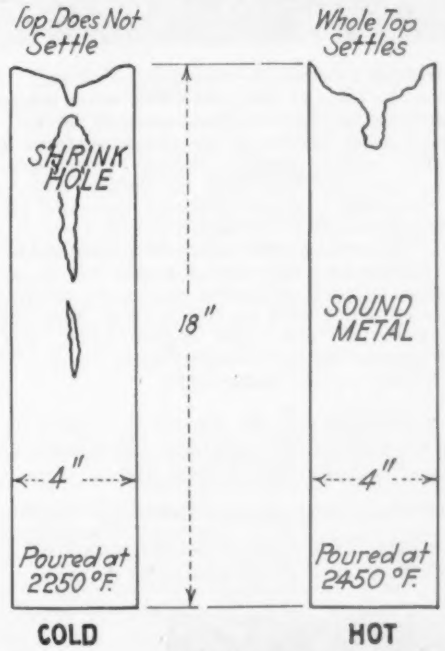



Fig. 1.—How Low Pouring Temperature May Produce Internal Shrinkage. Shrinkage is seen as jagged holes or spongy places. Shrinkage is due to difference in rate of cooling between two parts, or even portions of the same piece. In this case the outside of the lower temperature casting cooled too quickly for the inside. Dull iron also causes blowholes by entrapping gases and makes cold shuts by its sluggishness in running

Routine supervision of in-coming and manufactured materials is essential to standard construction. The functions of the gray iron research laboratory of the Niles Tool Works, Niles-Bement-Pond Co., Hamilton, Ohio, are to aid in the production of the best grades of castings and to extend the knowledge of gray iron metallurgy.

### High Test Specifications

The demand for better irons is reflected by recent high-test specifications. The tentative A. S. T. M. specification for high-test iron calls for 3800 lb. transverse on a 1¼ in. round bar, cast and tested as specified; it gives an optional tensile strength figure of 28,000 lb. per sq. in. (This is somewhat higher than the corresponding British specifications.) No analysis requirements are given, and the specifications cover these irons generally known as semi-steels. The requirements of these specifications are easily met and the adoption of these or higher specifications will act as an incentive to production of better grade irons. Unfortunately, these specifications make no provision for corrections to be used when applying them to irons of various section sizes and, especially, to very large heavy castings. The iron strongest in the standard test bar is not necessarily the one best adapted to use in a heavy section.

### Study of Structure Essential

The demand for better irons has also led to more thorough study of the material, gray iron. The reader knows that in case of steels and brasses (granting sound materials) the structure controls the physical properties. This fact is becoming more thoroughly established as research knowledge becomes more extensive. Research makes it plain that properties of gray iron, too, are largely determined by its structure.

While not as much work has been done on gray iron as has been done on steels, practical metallography promises concrete results to the foundryman. For example, in the case of the high-test specifications (mentioned above) designation of the approximate grain structure in a test block of size corresponding to the heavy sections of the casting is a more practical means of getting material of the correct physical prop-

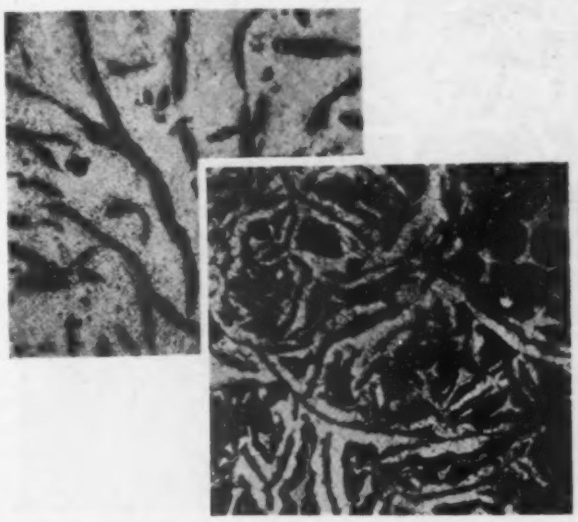


Fig. 2.—Open Grain. Sample (from 4-in. section of low strength iron) polished for microscopic examination. (Magnified 100 dia.) The large black flakes are graphite. Fig. 3.—(lower) A ferritic iron, combined carbon about 0.20 per cent. The white bands, surrounding graphite flakes, are ferrite. Ferrite is much the same in structure and properties as wrought iron or very low carbon steel. The dark areas are pearlite. The small dendritic forms showing some cellular structure are steadite. This iron had only 11,200 lb. per sq. in. tensile strength. Sample is shown magnified 65 dia., etched with picric acid

*Metallurgist in charge of research, Niles Tool Works Co., Niles-Bement-Pond Co., Hamilton, Ohio.

erties than a requirement for transverse strength on a bar whose size bears no relation to the sections of the casting.

The practical foundryman will be quick to recognize that microscopic study of a gray iron's structure is the old method of judging by fracture extended and refined. Its application is plain common sense, once a few tech-

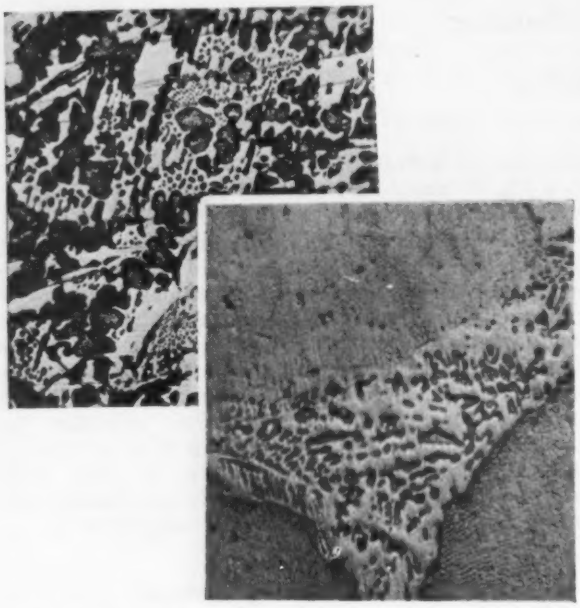


Fig. 4.—White Areas of Intensely Hard Component Cementite (Largely In Ledeburite Formation) in Mottled Iron, Polished and Etched With Picric Acid for Metallographic Examination. Magnification 100 dia. Fig. 5.—(lower) Shows effect of phosphorus. The hard formation, shown by relief polishing, is a phosphorus rich area (steadite). Magnified 600 dia.

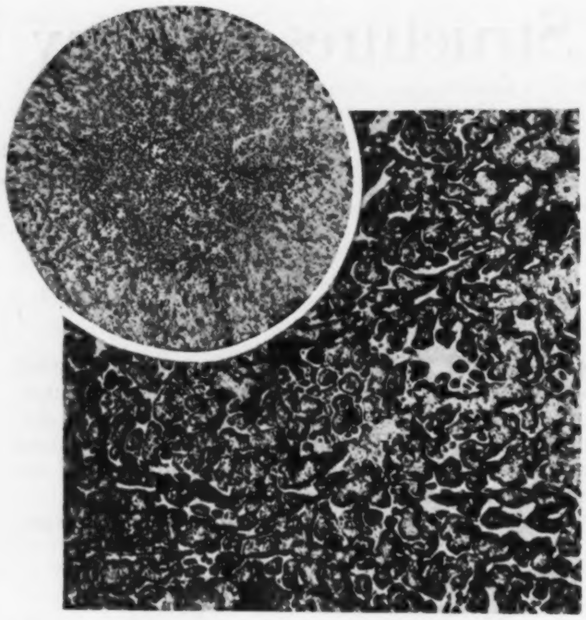


Fig. 8.—Mottled Fracture In Transverse Test Bar. Average combined carbon is 1.00 per cent. The white component is free cementite (See Fig. 4). The outside of the bar, cooling first, retains more carbon in the cementite form than the more slowly cooled center. Silicon 0.56; phos. 0.25; manganese, 0.43, S, 0.075 and T. Carbon 3.76 per cent (Slightly magnified). Fig. 9.—(lower) Cementitic areas near surface of high test bar. Combined carbon average of whole bar is 0.80 per cent and the structure a little distance from the edge is pearlitic. The skin of such a bar is very hard, but the inside is tough and strong, with small graphite flakes. Transverse 5000 and 4700 on two A.S.T.M. bars from same ladle. Silicon 1.07; phos. 0.27, sulphur 0.134, total carbon 3.28; and manganese, 0.49. Magnification 100 dia. etched in picric acid

nical expressions are mastered. Every one familiar with metals knows that fine grain size usually means greater strength. While making extensive use of methods of analysis and physical testing, metallographic microscopy actually enables us to see the structure of metals and to correlate these findings with a knowledge of actual shop practice. What we want to know is how to predict the service to be given by castings and to make better castings. Metallography uses the tools of microscopy analysis and physical testing.

**Soundness and Quality Determine Service**

The service of a casting is determined by its freedom from flaws and by the quality of material of which

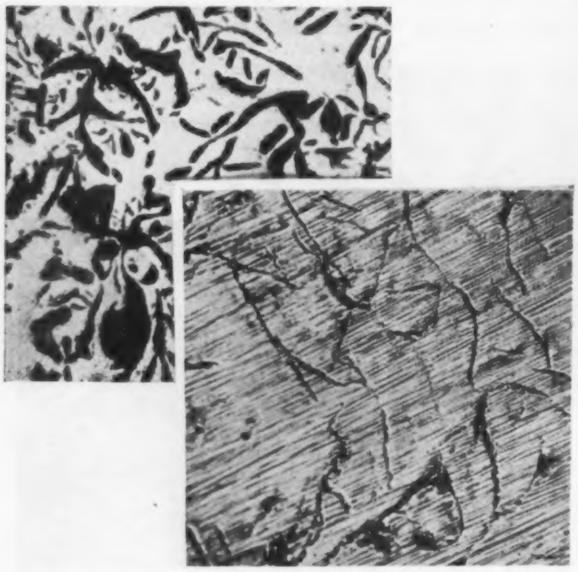


Fig. 6.—A Weak, Open Grain Cast Iron, Only 2500 Lb. Transverse (A.S.T.M.) Tensile 20,000 Lb. Per Sq. In. (Brinell, 131) as Taken From Center of a Heavy Section and Polished for Metallographic Examination. This bar on ordinary machining would appear open grained. However, a ground finish would make it *appear* like steel. (100 dia.) Fig. 7.—(lower) The same sample as Fig. 6, *ground* heavily on a fine wheel. Note how the peening action of the wheel has dragged the metal nearly over the large graphite flakes. Here is where microscopy comes in to show the true state of affairs, as in Fig. 6. (100 dia.)

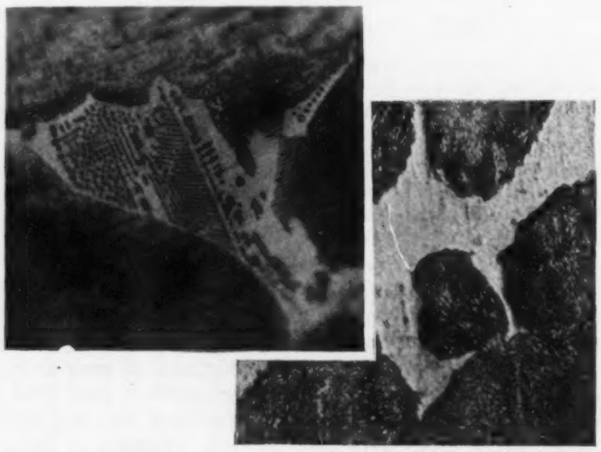


Fig. 10.—The Eutectic of Iron and Phosphorus In Cast Iron. Note the cellular or honeycomb structure. This structure is characteristic of certain eutectics. Ledeburite (austenite-cementite eutectic) and this phosphite form are found in cast irons. Researches in this laboratory have shown that phosphorus rich components (called steadite) are not necessarily of the eutectic type. It is also proved that phosphorus network is not essential for high-test irons. A fine network (when phosphorus is rather high) often indicates a general small grain size and therefore greater strength. The network, however, is an incidental phenomenon, a sort of secondary indicator, as it were. The micrograph shown is at a magnification of 735 dia., etched in bromine in amylalcohol. Fig. 11—(lower) Phosphorus rich component (steadite) in an iron low in phosphorus (0.17 per cent). The cellular structure is not evident, and this dendrite probably contains much less than the 10 per cent phosphorus necessary for the eutectic. Magnification 600 dia., etched in picric acid

it is made up. Design, molding, sand and melting practice are sources of unsound material. Shrinkage, blow-holes and scabs are common defects influencing the soundness of the metal. Troubles with excessive weakness, open grain, and hardness are often traceable to structure of the metal itself.

Impractical design often causes serious shrinkages. Different size sections set at different times. Shrinkage occurs when the set and still-contracting metal of a thin section draws away part of a still pasty metal of a large section, resulting in large jagged holes, generally under the skin of the casting. Section size should be kept as uniform as possible. Where design demands great variations, heavy sections should be tapered off into thin sections rather than joined with an abrupt change.

Dull iron (down around 2200 deg. Fahr. when poured) is a common source of internal shrinkage, blow-holes and cold shuts. Dull iron may be caused by poor coke, wrong air supply, very heavy scrap, improper charging ratios, and slow handling of ladles. Fig. 1.

**Workmanship and Science Necessary in Molding**

In molding, one is confronted with the human equation. To date mathematics has not found an exact solution for it. Placing gates and risers is a study in itself. Ramming, finishing and the numerous other details of everyday work play their part in getting good castings.

The work of the molding sand committee of the National Research Council and the American Foundrymen's Association has brought home to us the importance of using proper sands. Scabs and blow-holes are among the more prolific sources of castings losses in the average foundry. These are often due to sand or molding. It is sometimes very difficult to determine which is at fault.

It is necessary to consider the factors listed in the paragraphs above before jumping to the conclusion that castings troubles are due to the metal itself. Unsound castings are more often due to some detail in operation in the casting process than to the composition and structure of the metal. In the case of shrinkage, for example, a higher silicon, more largely graphitic, iron is less liable to shrinkage. But such an iron is weaker and more open grained. Care in design, in feeding, and the use of hot metal will often overcome shrinkage troubles. No changes should be made in the metal except as a last resort.

Weakness, open grain, hardness and related phenomena are due to properties of the metal itself. Poor metal cannot be expected to give high grade service. Weakness and open grain depend on the structure of the graphite flakes and of the combined carbon. Figs. 2 and 3. Hardness depends on the structure of the combined carbon and phosphorus forms. Figs. 4 and 5. These various structures are determined by the composition and the cooling rate.

**Open Grain Not Easily Judged**

By open grain the machine buyer means the coarse pitted finish found on some machined surfaces. The foundryman knows that an iron with a coarse dark fracture is likely to be weak and open grain, while a clear, light gray fracture gives an iron which will finish "close." He has also found that an iron with a mottled or white fracture will prove weak, brittle and intensely hard. Open grain means poor metal, but no man can tell the quality of irons by looking at the machined surface. Rather unorthodox, and at first glance paradoxical, isn't it? An open grain appearance in metal is caused by the coarse graphite and grain structure being torn out by the machining operation. The grain appearance on the casting surface can be varied at will by the type of finish. A little study of Figs. 6 and 7 will furnish food for thought. Fracture study is well enough, but cannot be applied in practice. We can't break the machine up to look at the fracture. Besides, fractures are not accurate enough guides and microscopic examination is much more easy, exact and informing.

**Cementite and Steadite**

When cast iron has combined carbon in the structural form of free cementite it is hard. When all its carbon is in the combined form, and therefore much cementite is present, the iron is "white" and intensely hard. This unreasonable hardness is due the cementite itself, as cementite is the hardest compound found among all the combinations of iron and carbon. (Illustrated by Figs. 8, 9 and 4.)

Phosphorus in cast iron unites with the free iron or ferrite (or sometimes with both ferrite and cementite) to form what is known as "steadite." This component is much harder than pearlite and ferrite (which form the bulk of the metal matrix) as can be shown by relief polishing. (Fig. 5). Distinct patterns due to steadite formations standing in relief are sometimes observed on milled surfaces. Research in this laboratory has shown that steadite in commercial irons contains varying amounts of phosphorus and does not necessarily exist as the eutectic 10 per cent phosphorus and 90 per cent iron. See Figs. 10 and 11. We have found that low silicon irons of great strength and readily machinable in thin sections become unmachinable on raising the phosphorus.*

*The researches of this laboratory have added many new facts to the knowledge of phosphorus forms and disproved some misleading theories.

*(To be concluded)*

## Progress in Industrial Standardization

BY A. W. WHITNEY†

During the past year, industrial standardization has continued to develop as one of the most active and important phases of American industry. Progress has been made in the standardization of raw materials, manufacturing processes and finished products. This is equally true whether looked at from the point of view of the factory, of the industrial or technical association, or of a national movement.

A striking development is the increased systematic use of specifications in public purchases, notably in the Federal and in several of the State governments. The National Association of Purchasing Agents and the National Council of Governmental Purchasing Agents are devoting much time and attention to the subject. At the direction of Secretary of Commerce Hoover, the Department of Commerce is preparing to publish a "Dictionary of Specifications for Public Purchases," which will make easily available information as to what specifications are in existence, to what classes of use they apply, and how they may be obtained.

The Federal Specifications Board has completed the second year of its activity. In this, the American Engineering Standards Committee has cooperated by obtaining criticisms from the various interested industries of proposed specifications of the Federal Government before the specifications are finally adopted by the board. To date, the board has adopted approximately 90 specifications, and the committee has secured criticism of industry on about the same number. From these systematic efforts to bring governmental purchases in line with the best commercial practice, important economies both to industry and Government are resulting.

The division of simplified practice of the Department of Commerce continues to exert a most stimulating influence on the standardization movement, particularly in emphasizing the efficiency results of standardization to the business man.

†Chairman, American Engineering Standards Committee.

# Detroit's New Automobile Sheet Plant

### Features of Works of Michigan Steel Corporation Include Short Hauls to and From Rolls and Quick Drying of Washed Sheets

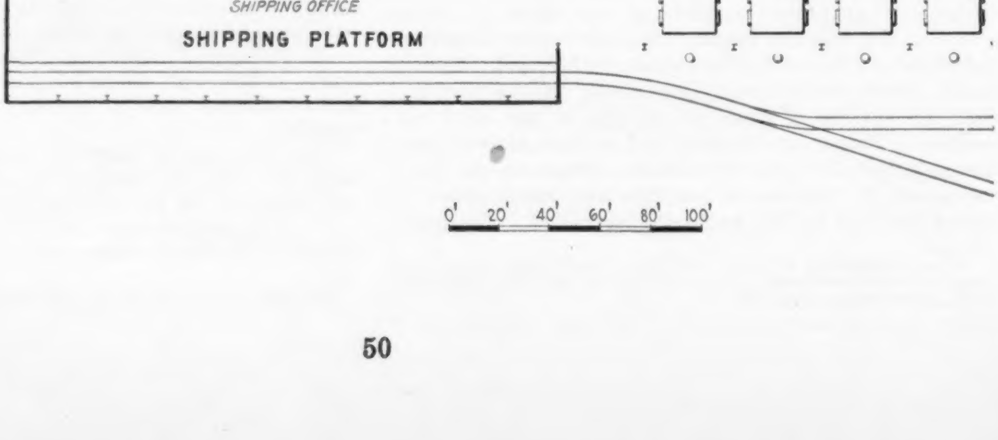
THE Michigan Steel Corporation has a six-mill plant, located at Detroit, and devoted almost exclusively to the production of automobile body, hood and fender sheets. It specializes in the treatment of special surface for enameling and in body sheets for difficult drawing and forming. The plant is distinctly modern, designed originally for the purpose named, and all equipment ordered to that end. The ground was broken for the plant in December, 1922, and the first sheets were rolled in July, 1923. The mill was in full production in August of the same year and has been operating at capacity since that time. The outlook at present for 1924 is highly favorable.

The design of the mill, steel in the construction of which was furnished by the Jones & Laughlin company, is as follows: The main building is 90 x 900 ft., with a sheet and pair furnace lean-to 25 ft. in width. There is a second building, 90 x 300 ft., in which sheet bars are unloaded and stored. In it are located also the bar shears so that the charging of bars into the continuous pair furnaces in this building — the pushers being motor driven—transfers the bars automatically into the main mill building. In the latter the material makes its progress through the various operations to the shipping platform at the extreme end of the building, so that there is no transfer of sheets from one building to another during the process of manufacturing. The process is progressive from the hot mill to the shearing, the shears being placed opposite the hot mills. The material is lifted by cranes to the pickle break-down building, which is of tile construction placed at about one-third the length of the building and built on to the main plant.

The drive is Mesta built, being herringbone, helical tooth design, with a speed reduction of ten to one. It is of especially heavy construction with approximately 100 per cent overload capacity. The mills are driven with a 1500 hp. General Electric motor, which provides for full overloads. All other motors in the plant, of which there are forty-seven, are the Crocker-Wheeler heavy steel mill type of capacities ranging from 5 to 250 hp. The cranes are of Morgan Engineering manufacture and pumps and air compressors are the Worthington make. The mill has a capacity of approximately 40,000 tons of sheets per year.

The furnaces were built by the George J. Hagen Co., Pittsburgh, and the pair furnaces are a special continuous type calculated to reduce and simplify the labor of pair heating, while materially facilitating and expediting production of the mills. The furnaces

From Sheet Bar to Finished Sheets, Manufacturing Is All Done in the One 900-Ft. Long Building, Planned to Minimize Handling by Manual Labor



are placed to reduce the length of the drag to the hot mills and also the distance the pairs must be carried and exposed to the air before breaking down. The housings for the hot mills are all of special design in heavy steel castings supplied by the Mesta Machine Co. The fuel used is West Virginia crushed coal burned in American underfeed stokers, motor driven. The results have been unusually satisfactory in the quality of heat, as the practice of the mill is the loose rolling method, charcoal dip, which with the softness of compressed air. The air is compressed in two stages, the first stage being at approximately 90 lb. pressure, after which the air is boosted to a pressure of 130 to 160 lb. The sheet pickler is of the usual steam type, heavy design, Mesta built and the usual practice of pickling sheets of this grade is followed. The exhaust steam from the steam operated Mesta pickler is recovered and cleansed, and used for heating pickle liquor, wash water, feed water for the boilers, etc.

Housings of the Hot Mills Are Notably Heavy

of the flame—ascribed to the type of furnace and fuel—has been reported successful in heating without the scale difficulties met in producing sheets of this class.

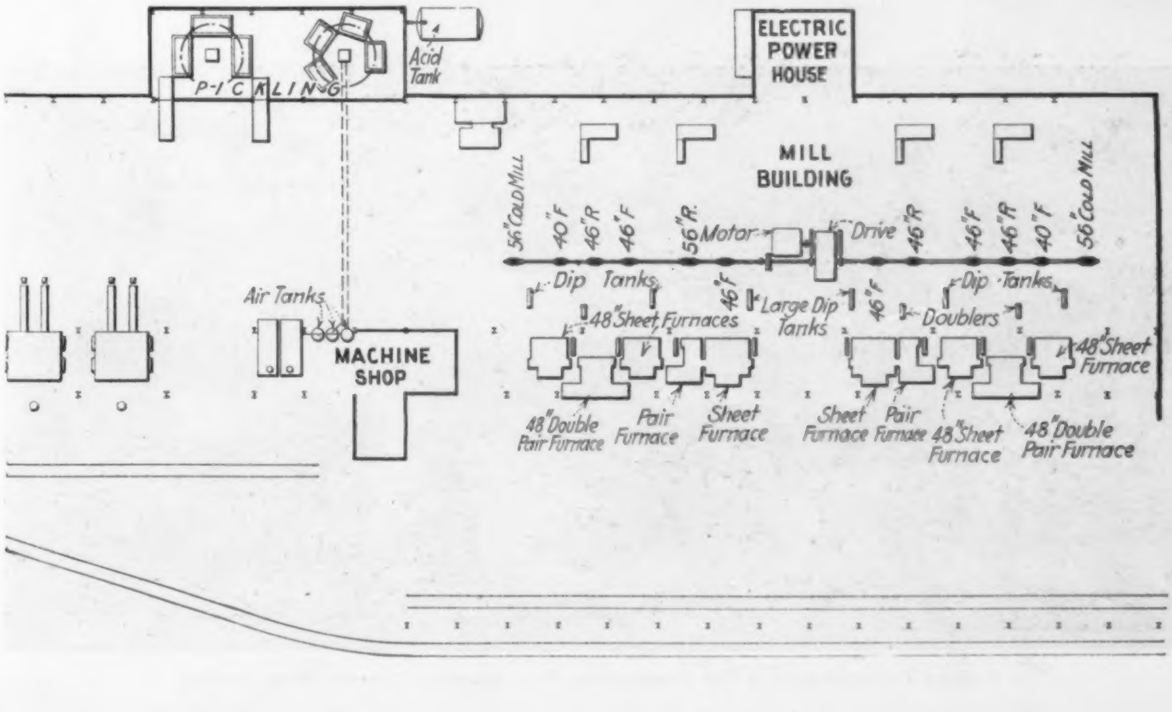
The tile constructed pickling building has asbestos protected metal for roofing. A special blower fan is used in this building to withdraw the fumes.

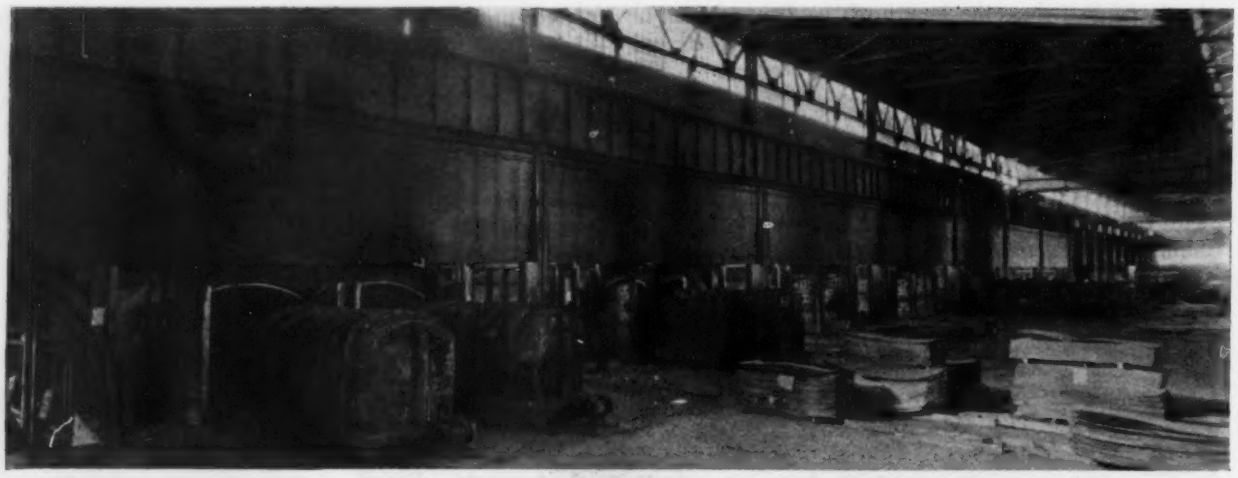
The distance between the catcher side of the hot mill and the break-down building is short to accomplish the carry in a short space of time. Material is run into the pickle break-down building on a narrow gage track. Two of these lines operate continuously, one carrying the incoming material and one the outgoing.

The particular style of pickling machine is the Mesta heavy duty air pickler. It is operated by means

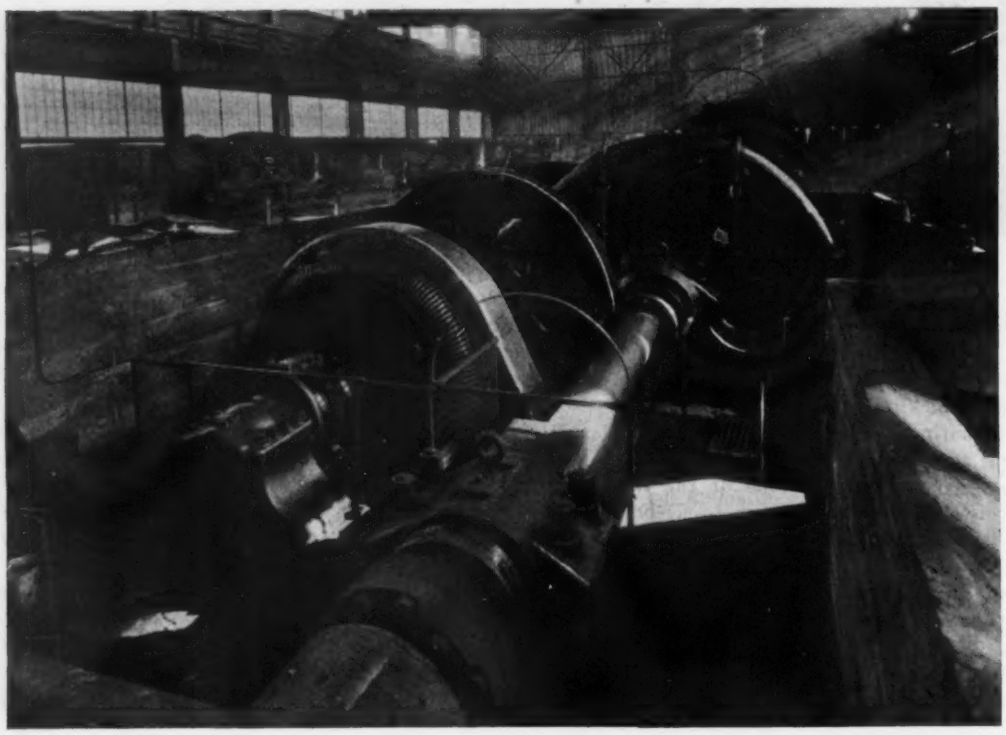
After the sheets have been pickled and washed, it is necessary that they be dried thoroughly in the shortest space of time so as to prevent stains and oxidation. To accomplish this, two drying machines of special design and construction are used, operating continuously on either side of the sheet pickler. Hot water is used, which is as near the boiling point as possible—in connection with rotating brushes and compressed air, which is used after the sheets pass through a pair of absorbing rolls.

In a direct line from the pickler is a battery of annealing furnaces. These are of the single chamber, double type, and are hand fired. The furnaces are specially designed to muffle the flame and secure a soaking heat of the proper temperature in the shortest

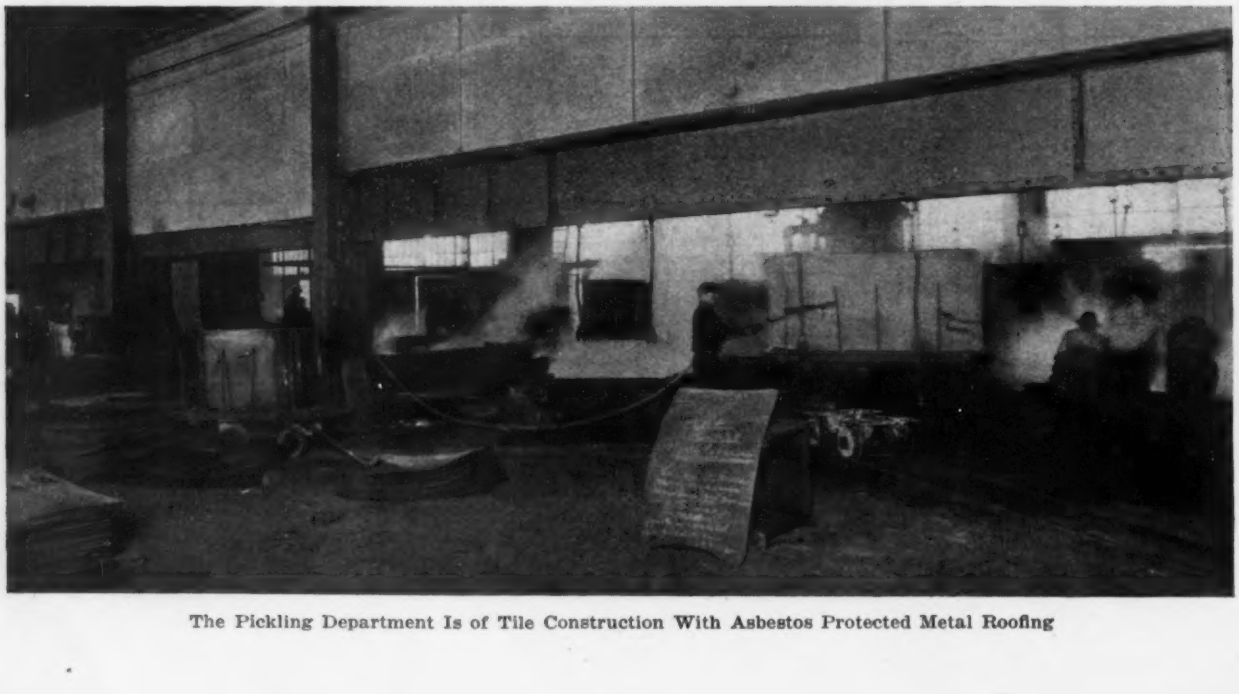




In a Direct Line From the Pickling Department Is a Battery of Annealing Furnaces



The Hot Mill Drive, in Line With the Mills, Is Through Herringbone Helical Gears From a 1500-Hp. Motor and Is Designed to Take 100 Per Cent Overload



The Pickling Department Is of Tile Construction With Asbestos Protected Metal Roofing

The Cold Rolls Are in a Direct Line From the Annealing Furnaces and Beyond Them Are the Roller Levelers and the Re-squaring Shears

possible time. Standard cast steel annealing equipment is used.

From the annealing department, material passes to the cold rolls, which are in a direct line, the roller levelers being placed in line with the discharging end of the cold rolls, and in line with the re-squaring shears. The stretcher leveler used in the plant was supplied by the Hyde Park Foundry & Machine Co.

The loading platform is at this end of the building, having a six car capacity, as is also a loading arrangement for trucks by means of a crane. This feature has been much utilized by local customers. The plant is located at Ecorse, which is nine miles from the center of the city. The site proper is at the junction of the Detroit and Ecorse rivers and the water supply for the mill is pumped from the Ecorse River. The location is within easy trucking distance of the largest high-grade sheet consuming district in the country and this had much to do with the location of the mill at this place. Many transportation delays are eliminated in delivery with the market for the product at the plant's back door, so to speak. The consumption of high grade sheets in this territory alone is many times the capacity of the plant.

The plant is served by two trunk lines, the New York Central and the Detroit and Toledo Shore Line. While the company's plants, tracks and storage space cover only about ten acres, they have approximately 35 acres available, so it is obvious that there is ground space available for plant extensions such as the future may require.

Frederick B. Lovejoy, Wheelock, Lovejoy & Co., New York, is chairman of the board of the company; George R. Fink, formerly with the West Penn Steel Co., is president and treasurer and Frank H. Jones, Worthington Pump & Machinery Corp., New York, and Herbert M. Steele, formerly with the Newton Steel Co., are vice-presidents.

The Loading Platform Accommodates Six Cars and Has a Crane for Loading Trucks

# Transportation and Pig Iron Costs

## Analysis of What the American Consumer Pays for Freight—Effect of Location and Distance—Assembling and Distributing Charges

BY PAUL M. TYLER*

A THOUGHTFUL observer has remarked that all mankind is engaged in the simple work of moving things from one place to another. While the movement of iron ore, the transfer of ink to paper, or the sewing of buttons on a pair of trousers ordinarily has a deeper purpose, the philosopher is right to the extent that the "creation of place utilities," as it is called in the jargon of the economist, is one of the most important functions of modern industrial activity. And in few industries is the item of transportation of greater importance than in the manufacture of pig iron. In some favored localities coal and iron ore are found side by side, but more commonly fuel, ore, or both must be carried long distances before they can be dropped into the skip of a blast furnace.

PAUL M. TYLER

Since they are so seldom found together, there has been much discussion as to whether it is more economical to bring the ore to the coal or to bring the coal to the ore. The late J. E. Johnson, Jr., also called attention to a third—and frequently quite as important—factor in the situation, namely, the freight on the product from furnace to market. Two tons of ore are commonly needed to make a ton of iron and only 1½ tons of coal are required. If the coal is made into coke at the mines, only about one ton of fuel need be shipped to the furnace plant. Pig iron, however, is itself a bulky commodity and, despite the ease with which it can be handled, it cannot be carried far without adding largely to its cost.

What is the actual measure of this penalty that the consumer of pig iron has to pay because his foundry is not situated in juxtaposition to coal and ore mines?

It is obviously impossible to prepare any national averages to show what this burden is. But I have assembled a fair amount of data from which rough estimates can be made for a few important centers of consumption and production in the United States. Especially in the Eastern part of the country furnaces use a constantly changing ore mixture, which varies not only with the character of the iron made, but also with the cost and availability of iron-bearing materials delivered at the plants.

### Foreign and Domestic Ores

Sometimes foreign ores are cheaper and sometimes domestic ores. The growing use of magnetite from both New York and New Jersey and the general employment of pyrite residues, puddle cinder, and scrap of all kinds further complicate the problem. It is possible, however, to arrive at an approximate idea of the amount of freight paid for the assembly of raw materials required to make a ton of iron in representative localities in the different producing districts, after which it is a simple matter to add the freight on the product to consuming points.

*Consulting metallurgist (formerly Chief of Metals Division, United States Tariff Commission).

The first step toward such an estimate is to analyze the raw material situation in each district and tabulate the quantities commonly employed of each constituent of the typical charge. Knowing the quantities of materials and their sources, the total freight cost for each district can then easily be calculated. To simplify the calculations, it is necessary to ignore scrap and certain other secondary materials and to group the ores into a few general classes. The former assumption may be defended in a measure when it is considered that most of the secondary materials either have been or might have been derived from pig iron made from primary materials assembled from practically the same localities as are furnishing current supplies.

The geographical classification of the ores needs no apology. Lake ore, for example, can be fairly assumed to be a mixture of 60 per cent Mesabi and the remainder old range ores, the total rail and water freight on which to Lower Lake ports would be about $1.65 per ton (including unloading). Pyrite residues, cinder, etc., can in most cases be grouped with "local ores" and a fair average freight rate applied which will closely approximate actual conditions. There is little complication in this grouping except in the eastern part of Pennsylvania, where the plants are more scattered and where differences in practice are more marked than in other districts. I have visited most of these plants recently, however, and within reasonable limits can vouch for the accuracy of the estimates of total freight charges, both as to "local" and "foreign" ores, in this area.

### Paradox of Coke and Coal Rates

It is a trifle more difficult to arrive at an appropriate estimate for the average freight charges on coke. By-product ovens are run in conjunction with many furnace plants, whereas others purchase their coke, either from ovens close to the mines or elsewhere. There is no fixed relation between the freight on coal and the freight on coke. In some localities the freight on a net ton of coke is actually greater than that on a gross ton of coal and invariably the freight on the coal equivalent (about 1.28 gross tons) of a short ton of coke is greater than the tariff rate on coke.

In this discussion it will be assumed arbitrarily that coal is coked at the mines and the coke transported thence to the furnace plants. While this might appear to result in underestimating the situation, one may take it for granted that the difference between the freight on coke and the freight on the equivalent weight of coal can fairly be borne by the oven byproducts and the gas rather than by the blast furnace department.

With these explanations the following table may be submitted:

*Typical Furnace Mixtures in Various Districts*
(Tons per Gross Ton of Pig Iron)

| Material | Alabama | Eastern Pennsylvania | Virginia* (a) | Virginia* (b) | Buffalo | Valleys† |
|---|---|---|---|---|---|---|
| Ore: | | | | | | |
| Lake | nil | 0.5 | nil | 1.0 | 1.9 | 1.9 |
| Local | 2.75 | 0.9 | 2.15 | 0.5 | nil | nil |
| Foreign | nil | 0.5 | nil | 0.5 | nil | nil |
| Coke†† | 1.4 | 1.1 | 1.25 | 1.15 | 1.05 | 1.0 |
| Stone | 0.15 | 0.5 | 0.3 | 0.35 | 0.45 | 0.45 |
| Total materials | 4.30 | 3.50 | 3.70 | 3.50 | 3.40 | 3.35 |

*Virginia furnaces (a) producing their own ore and (b) partly dependent upon outside ore.
†Mahoning and Shenango Valleys; Youngstown as central point.
††Coke weights calculated into gross tons to conform with the weights of ore and stone.

While the Connellsville region is by far the largest source of supply of blast furnace fuel in the United States, the freight rates from Connellsville to the different districts do not in all cases reflect the true situation. The Birmingham district gets essentially its whole supply of coal, as well as ore and flux, from local mines and, in Virginia, Pocohontas and New River coal and coke are used more commonly than Connellsville. West Virginia coal and coke are also used to a considerable extent in Cleveland and other places.

In the accompanying table of freight rates, a composite figure is given in some cases in order to take account of the actual proportions of fuel consumed and, where the rates are not equalized to all parts of a district, it also includes an adjustment designed to produce a rough average for the district. Thus in eastern Pennsylvania, while the rates on coke from Connellsville range from $3.28 for Reading and vicinity up to $3.53 for Bethlehem and Philadelphia points, the composite figure for all plants in the district is taken at $3.35 per net ton ($3.75 per gross ton).

*Estimated Average Freight Rates on Principal Materials*

(Per Gross Ton of Material)

| Material | Alabama | Eastern Pennsylvania | Virginia | Buffalo | Valleys** |
|---|---|---|---|---|---|
| Ore: | | | | | |
| Lake | ... | $3.65 | $3.80 | $1.65 | $2.55 |
| Local | $0.40* | 1.80 | 0.60* | ... | ... |
| Foreign*** | ... | 0.80 | 1.80 | ... | ... |
| Coke**** | 0.40* | 3.75 | 2.05 | 3.60 | 2.55 |
| Stone | 0.60* | 1.10 | 0.60* | 0.25[a] | 1.25 |

*Nominal switching charges, most of the transportation being done by railroads owned by the furnace companies.

**Mahoning and Shenango Valleys; Youngstown as central point.

***American rail freight only; ocean freight not included.

****Coke rates (usually quoted per net ton) converted to gross ton basis.

[a] Estimated charge for shipment in barges owned by quarry companies (sold delivered at plant).

Combining these two tables we arrive at the total freight cost in making a ton of iron as follows:

*Total Assembling Costs of Foundry Iron, per Gross Ton*

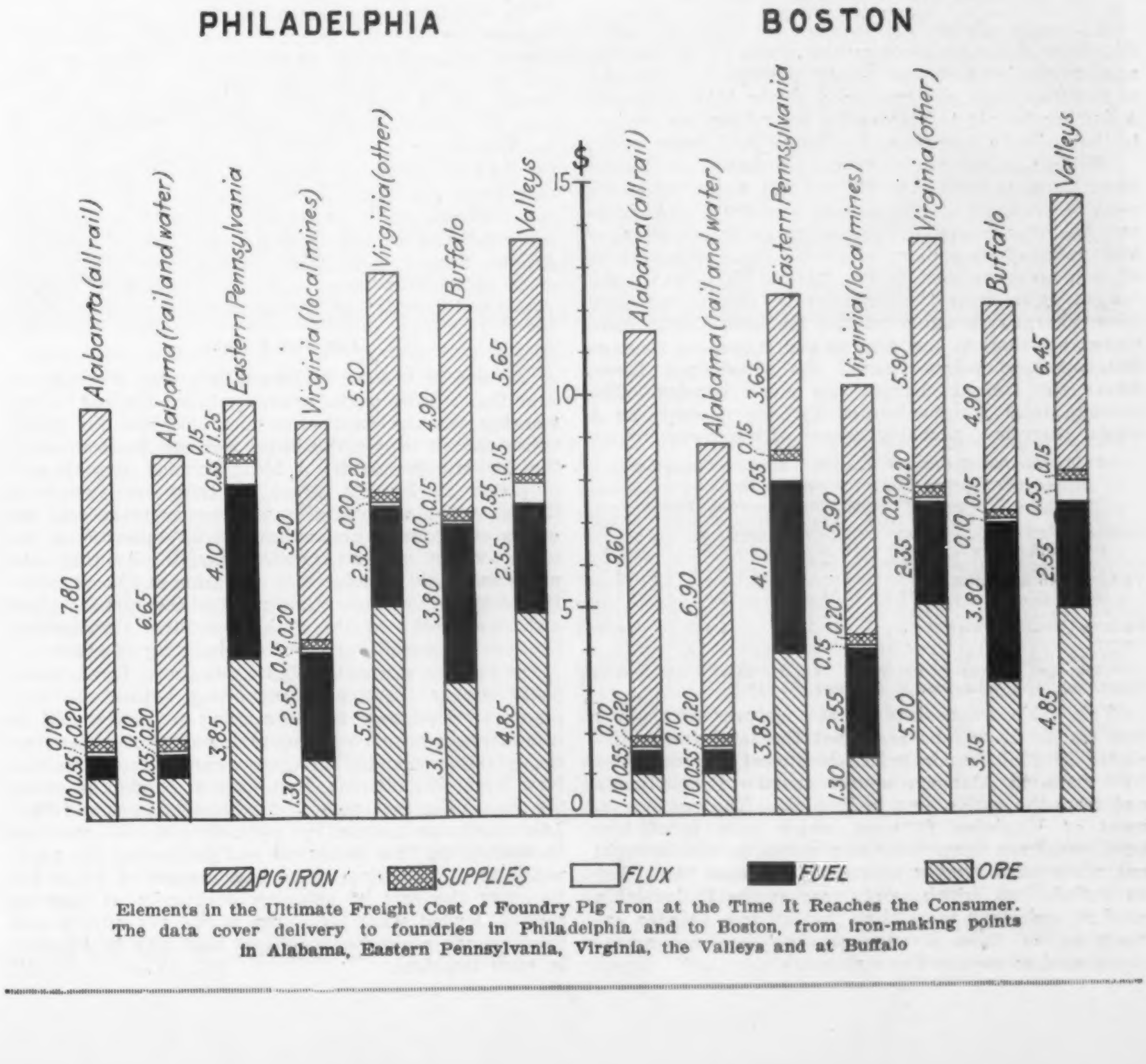
| Material | Alabama | Eastern Pennsylvania | Virginia* (a) | Virginia* (b) | Buffalo | Valleys |
|---|---|---|---|---|---|---|
| Metallic mixture | $1.10 | $3.85 | $1.30 | $5.00 | $3.15 | $4.85 |
| Coke | 0.55 | 4.10 | 2.55 | 2.35 | 3.80 | 2.55 |
| Stone | 0.10 | 0.55 | 0.15 | 0.20 | 0.10 | 0.55 |
| Supplies (estimated) | 0.20 | 0.15 | 0.20 | 0.20 | 0.15 | 0.15 |
| Total | $1.95 | $8.65 | $4.20 | $7.75 | $7.20 | $8.10 |

*Virginia furnaces (*a*) producing their own ore and (*b*) partly dependent upon outside ore.

The writer admits a certain surprise that the cost of transportation does not appear higher than the accompanying tabulation indicates. Various estimates as to the payments to the railroads have run up to $10 a ton and more; in few cases have they been less than $8.50 per ton of iron. Most of these estimates, however, have been obtained by applying current freight rates to the quantities of materials formerly used. They have been based upon pre-war conditions and ignored the fact that the blast furnace operator must get his materials in the cheapest market.

A few years ago Pennsylvania furnaces were operating principally on Lake ore and during the war it was difficult for them to secure foreign ore except from Cuba and most of the Cuban ore was produced by steel companies for their own consumption. At present the freight on 1.9 tons of Lake ore would amount to $6.95 per ton of iron ore and, if this ore were used exclusively, the freight cost of making foundry iron at Reading or Pottstown would be over $11.50 per ton.

By judiciously mixing magnetite ores from New York and New Jersey, pyrites residues and foreign ores of various kinds, and using only enough Lake ores to balance up the mixture, many operators in the East-




Elements in the Ultimate Freight Cost of Foundry Pig Iron at the Time It Reaches the Consumer. The data cover delivery to foundries in Philadelphia and to Boston, from iron-making points in Alabama, Eastern Pennsylvania, Virginia, the Valleys and at Buffalo

ern territory have cut their freight bills in half. That this situation is likely to persist for some time is evidenced by the fact that imports of foreign ore during the first nine months of this year have been greater than for any year in the history of the iron trade. While this is in part due to the unusual cheapness of Swedish ores, resulting from the absence of demand from Germany, there has been an enormous increase in imports from northern Africa, whose ores are more nearly like the varieties mined in the Lake Superior region.

**Virginia Mines Exhausted**

In Virginia, likewise, the state of affairs has changed. The industry in that State was established upon the basis of local ore deposits which, one after another, have become exhausted. As will be seen by comparing the two sets of figures for Virginia, the possession of local ores means an advantage so overwhelming as to spell the difference between success and failure. These nearby ores are cheaply mined and are mostly of excellent quality, but their main attraction is their proximity, which permits their delivery with only a nominal switching charge between the pits and the furnaces—a condition which subsidizes fortunate owners $3.50 for every ton of iron made.

In their struggle for existence some of the furnace operators whose nearby ore bodies have become exhausted have now turned to foreign sources of supply. The total freight charge of $3.80 per ton, as here presented, while perhaps not excessive in view of the remoteness of the Virginian plants from the Lake Superior mines, is nevertheless resulting in the rapid elimination of Lake ore from their furnace mixtures and material increases in the arrivals of foreign ore at Norfolk. A favorable feature of the Virginian industry brought out by the accompanying tables is that many of the furnaces in that part of the country are more favorably situated with respect to getting fuel than those in any other district except Birmingham and Pittsburgh.

**Delivering the Iron to the Consumer**

The railroads are not through with pig iron when they have delivered the requisite materials to the furnace stockpiles and bins. Only insignificant tonnages of merchant iron are consumed at the blast furnaces. A further freight toll is exacted for taking the product to the ultimate consumer, 3 miles or 3000 miles away.

While this toll varies from less than a dollar, for short hauls, to more than $15 per ton, according to the relative locations of furnace and foundry, Philadelphia and Boston can probably be taken as points more or less typical of the country as a whole. Large quantities of iron are consumed in the Middle West, where the freight rates from the furnaces are much less than those charged to either of the seaboard points mentioned, but there is also a large and increasing tonnage distributed to points beyond the Mississippi River, where the freight charges are much heavier. The average total freight burden for the country as a whole, therefore, probably comes within these limits:

*Total Combined Freight Cost to Ultimate Consumer*
(Per Gross Ton of Foundry Iron)

| From | At Philadelphia Rate on Iron | At Philadelphia Total | At Boston Rate on Iron | At Boston Total |
|---|---|---|---|---|
| Alabama—all rail... | $7.81 | $9.75 | $9.61 | $11.55 |
| Rail and water.. | 6.67* | 8.60 | 6.91 | 8.85 |
| Eastern Pennsylvania | 1.25** | 9.90 | 3.65 | 12.30 |
| Virginia—local mines | 5.17 | 9.40 | 5.92 | 10.10 |
| Other .......... | 5.17 | 12.90 | 5.92 | 13.65 |
| Buffalo ............ | 4.92 | 12.10 | 4.92 | 12.10 |
| Valleys (Youngstown) | 5.63 | 13.75 | 6.43 | 14.55 |

*Dock delivery $6.01.
**Average. Rates range from 76c. to $1.39. (Sparrows Point, Md., and Wharton, N. J., rates, $1.64).

This table emphasizes certain features of the pig iron trade. It will be seen that the total freight included in Philadelphia prices is almost the same for iron made in Alabama as for eastern Pennsylvania and from the native ores in Virginia. The embarrassment of Virginian furnaces which have insufficient supplies of ore from their own mines is also brought out, their total freight amounting to more than that on Buffalo iron, which rarely reaches the Philadelphia market, and much more than that on iron shipped entirely by rail from Birmingham (which is not extensively used in eastern Pennsylvania).

Similarly, in Boston, the total freight charges bring out the market situation in that eastern Pennsylvania, Buffalo, Virginia and Birmingham irons are all nearly on an actual freight parity, despite the wide spread between the rates on pig iron itself.

**Increases Since the War**

It might be of interest to go into a careful comparison of present-day freight costs with those existing before the war, and perhaps even to go back to those in operation when the industries were established in the different districts. Changes in sources of supply of raw materials greatly complicate the preparation of such comparisons except in individual cases. Hence it does not seem worth while to delve into the history of these changes to the extent that would be necessary for a useful study of the proposition.

In general, it may be noted that Birmingham's position has been greatly strengthened as compared with that of other producing districts. In the first place, the percentage increases in the cost of transporting pig iron to consuming centers has been less than elsewhere, because of the competition of water routes. In 1907, for example, the rail and water rate on iron from Birmingham to Philadelphia was $4 and to Boston $4.60 per ton, which latter compares with present figures only 50 per cent higher. During the same period the rate from Buffalo to Philadelphia has gone up 86 per cent and that from Buffalo to Boston has advanced 101 per cent. The average increase in the whole structure of pig iron rates is probably somewhere between these last two limits, or from 1½ to 2 times as much as the increase in some of the rail-and-water rates from Birmingham.

Rates on ore and on fuel have not been increased quite so much as have those on the finished product, amounting in many cases to about 75 per cent on coke and about 60 per cent on ore; but these rates have been affected even more than those on pig iron by local readjustments.

In addition to favorable treatment as regards percentage increase in transport rates, Birmingham's industry is also fortified by the unique position it enjoys among domestic districts in that so small a fraction of the cost of making iron goes out for freight. Even now the assembly cost of raw materials is under $2 per ton, whereas in other sections it amounts to from two to four times this figure. It is obvious, therefore, that even the same percentage increases in freight rates would result in much smaller increments on Alabama costs than they would add to costs elsewhere. Another factor working in this same direction is that much of the transportation in Birmingham is on lines owned and operated by the furnace companies.

**For the Future**

Instead of looking backward, however, it would appear that a more useful study could be directed toward working out the most economical location for plants which should supply the large markets for iron along the Atlantic seaboard. A blast furnace plant is now projected at Everett, Mass., a tidewater suburb of Boston, which will probably utilize coke from local gas works and foreign ore, which can be delivered at the plant without railroad transfer charges. Another tidewater merchant furnace is in operation at Chester, near Philadelphia, and near Baltimore is the furnace plant and steel works of the Bethlehem Steel Corporation. Present day conditions favor the building of others.

So long as railroad freights remain at levels materially higher than those prevailing before the war, plants situated near the consuming centers should be in a stronger position for supplying these markets than those farther inland. Foreign ore can be had at Boston, New York, Philadelphia, Baltimore or Norfolk at about the same price that prevails for Superior ores at Lower Lake ports and, since the only freight cost involved in assembling raw materials and delivering the product is local switching, there is a margin of $8 to $10 to cover the cost of shipping such coke as may be needed beyond what local gas works can supply and to cover any other disadvantages that may be inherent in such locations.

# Manufacturing Seamless Steel Tubing

## Piercing by Rolling on Askew Mill of Mannesmann Type Followed by Rolling to Proper Wall Thickness and Reducing to Finish Size

BY E. R. KELSO*

GREAT increase in demand for seamless steel tubing by the automotive industry within the last two years would by itself foretell a very bright future for this branch of tubular production. That the rate of increase of this demand is very rapid is shown not alone by the increased production of cars but, more particularly, by the new uses found almost from month to month by the engineers of different automotive companies and their speedy adoption by the rest of the field.

Working hand in hand with the metallurgist in a constant endeavor to lighten and strengthen, the engineer has found an almost unlimited opportunity to substitute seamless steel tubing for solid rounds and for castings. Following are a few of the more important to date:—Front and rear axle housings, drive shaft housings, drive shafts, wrist pins, oil piping, cross tubes for frames, steering columns and rods, drag links, roller bearings and shafts.

Yearly demand in this field is now about 150,000 tons, or nearly one-fourth of the total annual capacity of the country, which is more than the largest producer could make of this class of tubing. There has been comparatively little added to the capacity of the country since this demand has sprung up. Also, the demand is constantly increasing for mechanical tubing in a great variety of lines outside of the automotive, and the same is true of seamless boiler tube and pipe for the oil fields.

Of particular importance to producers of welded pipe is the development during the last two years of the seamless coupling. It would be difficult for them to attach too much importance to the effect of this demand.

*Formerly with National Tube Co., later chief engineer Weldless Tube Co., Wooster, Ohio, now with Mackintosh-Hemphill Co., Pittsburgh.

This article is attempted with the idea of explaining to the many new users the process of manufacturing seamless steel tubes from solid round bars, in non-technical language and without going into the problems of design and production.

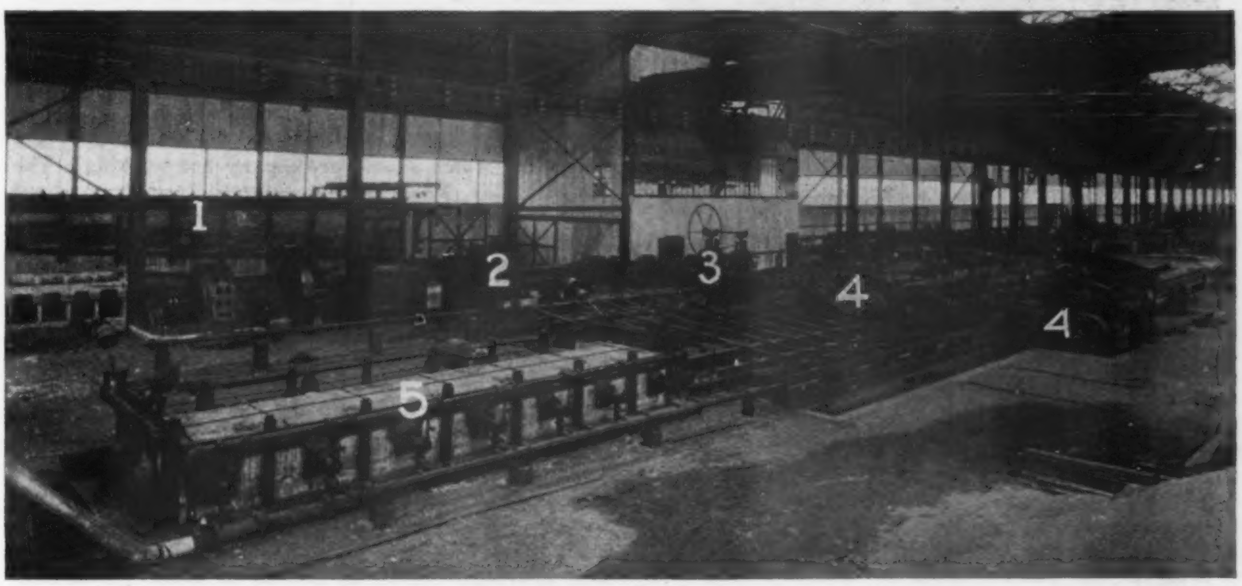
### Cutting and Centering the Rounds

If the plant has a bar mill connected with it, the rounds are hot sawed into the required length, according to order, and hot centered at the bar mill and before the bar has cooled from its rolling heat. Centering is omitted by some manufacturers.

If the plant does not have a bar mill, the steel rounds are purchased from an outside source and stocked, usually from 14 to 30-ft. lengths. The diameters vary from about 2¾ in. to 8 or 9 in., according to the capacity of the mill and size tube to be made. The cutting up of these stock bars into the required length for piercing is done either by heating and hot sawing or by cold shearing. Mention will be made later of the method used in determining the length of billet for a certain tube.

While centering is not done by all producers, it is generally conceded to be good practice. This operation consists of punching (in case of hot billets) or drilling (when cold) a hole about ⅞ in. diameter by ⅞ in. deep in the center of one end of each billet. These ends are kept the same way in the cradles and started into the furnace turned so that the centered end will be the forward end of the billet as it enters the piercing mill.

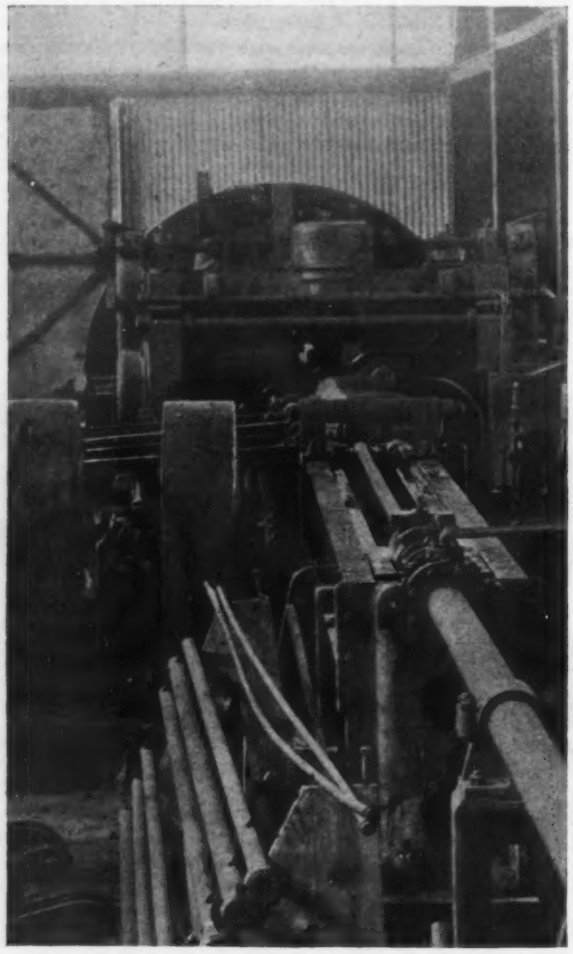
Centering, while necessary for a disk type piercing mill, is not necessary for the modern roll type mill with which this description will deal. When billets are cold sheared, instead of hot sawed, one-half of the fracture is fairly smooth and the other half rather ragged. The ragged end cannot be drilled for center-




General View of the Hot Mill of the Weldless Tube Co., Wooster, Ohio (Described in THE IRON AGE, May 17, 1923, Page 1399). At 1 is the heating furnace for the piercing mill (2). The rolling mill is at 3, with two reelers at 4, 4. A reheating furnace is at 5

ing without center punching first, which would be too expensive. The smooth end can be center drilled, but this leaves the ragged end as the last end to go through the piercing mill. With a smooth fracture or sawed end, the tube will have a more or less rough and broken end.

This condition is exaggerated with a ragged end billet, and long fins form which break out at right angles in later operations, causing very troublesome stickers. Therefore centering was omitted and the "bad" end put through first, when the tendency would be to force the excess metal back into the wall of the tube instead of tearing it out further. As the ends of



Outlet End of the Piercing Mill, Showing Mandrel Upon Which the Pierced Billet Rides as It Comes From the "Askew" Rolls. Inclined skids at left center transfer the pierced billet to the automatic hot rolling mill, the gear case for which cuts off part of the view of the skids

the tube are later cut off, this does not affect the tube quality.

It has been popularly supposed that the object of centering was to reduce eccentricity in the tube. This has never been proved; in fact, there is much evidence that centering does not help produce a concentric tube. Tubes are made reasonably concentric without centering and, even when the billets are centered, some of the holes are so far off center that it would seem they would tend to produce eccentricity. A centered tube is easier on piercer points and requires perhaps less power at the start of the piercing operation.

### Heating the Billet

Heating for piercing is done in a continuous type furnace which lends itself admirably to the operation. The furnace bottom is inclined from the charging end to the hearth about ¾ in. per foot. The billets roll down the incline with some help applied through poke holes in the sides, getting hotter and hotter as the hearth is approached, at which point the drag-out door is located. The burners are located at the bottom end and pointed up the furnace, the stack being at the top and the draft pulling the flame up the furnace, baffle walls and a dip in the arch retaining a good part of the heat at the bottom end. The draft and forced air can be controlled so as to heat as far back as desired.

Careful design of the furnace is important not only to conserve fuel but to provide a furnace that will bring sufficient tonnage per hour up to the required heat. It should be wide enough to accommodate a double row of medium length billets.

The best fuel is natural gas; oil and producer gas also make good fuel. Powdered coal is also used but, if not properly pulverized, it leaves a deposit on the billets which causes a serious defect. Natural gas is easily controlled and handled and a mill that has a sufficient quantity of this fuel available is extremely fortunate.

Great care must be exercised to have the steel at the right temperature when drawn. A pyrometer should be used. The proper heat varies with the carbon and other alloy contents of the steel, and with the diameter of the billet. The range is about 1050 to 1200 deg. C. (1925 to 2200 deg. Fahr.), varying inversely with the carbon content.

The billets are either drawn from the furnace by hand or pushed out by air and dropped into the receiving trough of the piercing mill.

The first requisite to proper heating is a uniform rate of drawing the billets from the furnace. It can readily be seen that delays on the mill, whether from breakdowns or changing orders, will seriously affect the heating.

If the steel is too hot it does not retain enough of its tensile strength and will twist apart in piercing—it becomes too plastic. There is also an excessive loss from scaling. If too cold, the effect is detrimental to the structure of the steel, that refinement of grain being lost which should accompany hot working. The inside cracks, which will be referred to later, will not weld. Eccentricity of wall, increase in power consumed, and added wear and tear on machinery are other effects of under-heating.

### Piercing on Mannesmann Type Rolls

Fig. 1 shows the essentials of the piercing operation, which is of course the vital one in seamless production. The object of all subsequent operation is to finish the tube produced in the piercing mill. The roll type of mill is described. There are several disk type mills in use but most all new mills for several years have been of the roll type. The process is the same in either case.

Rolls *A* and $A_1$ driven through a gear reduction drive in all late mills by motor and mounted on suitable bearings, rotate as shown, or clockwise looking from the entering side. They may be from 16 in. to 36 in. or larger at their largest diameter, with a flat part for about an inch long in the center and tapering toward both ends. They will run at about 750 ft. surface speed and are tilted or inclined from the horizontal, each in the opposite direction, so that their axes cross at the center. This inclination will vary from 5 to 8 deg.

Roll *A* is slightly larger than roll $A_1$. The roll which is revolving down when in contact with the billet should have a slightly faster surface speed; this tends to keep the billet *B*, which also turns or spins between the rolls, down on the lower guide. It will be understood that there are entering and delivering troughs or guides and top and bottom guides between the rolls, all of which hold the billet in position to be worked on. The piercer point *D* is detachable from the mandrel rod *C*, which holds the point against longitudinal movement, allowing it to spin with the tube however. The point is roughly about ⅛ in. smaller in its largest diameter than the inside diameter of the desired tube and tapers down to a blunt point toward the entering end. The mandrel rod is somewhat smaller than the largest part of the piercer point, to keep the tube from sticking on the mandrel, which happens whenever the point is left off by mistake. The mandrel rod is kept as large as possible to prevent bending and breaking, and is backed up by a thrust bearing which allows it to rotate.

Heat from the billet, the temperature of which actually rises during piercing, has to be contended with and streams of water fall constantly on the rolls $A$-$A_1$ their bearings and spindle couplings. The piercer point becomes red hot on the tip and has to be changed after each tube. The mandrel rod is water-cooled, being hollow, and a water pipe extending inside of it up to within an inch or two of the piercer point.

### Feed Due to Angularity

It can readily be seen that, with the rolls revolving and tilted, anything gripped between them would be fed through. If the rolls were tilted 90 deg. they would be at right angles to the long axis of the tube and would be the same in effect as a common rolling mill, in which case the feed would be approximately the same as the surface speed of the rolls. If the rolls were not tilted at all, but were horizontal, there would be no feed and the tube would simply rotate in one place between the rolls if it were placed there and the rolls closed in. Anyone with a little mathematics can figure what the theoretical feed would be for any surface speed at a given angle. This feed will be approximately 80 ft. a min. The angle of tilt depends, or should depend, on the wall thickness of the tube to be made.

Most of the mills are built with practically a fixed angle, or at least it is a half-day to a day's job for the entire crew to change the angle. The latest type piercing mill admits of changing the angle within 5 min. to accommodate any wall thickness for different orders. This is a very important feature, in that it enables the mill to be kept up to capacity instead of running several wall thicknesses at the same angle on account of the time involved in the change. Another important feature of this mill is the fact that a motor drive operates to spread the rolls quickly and also raise the top guide. This feature is extremely useful whenever a sticker happens—that is, when a tube becomes stuck in the mill because the piercer point was left out or got askew or for other reasons. The spreading of the rolls and raising of the guide makes a clear opening through the mill and the sticker can be pulled out easily.

### Action of Askew Rolls

With the rolls rotating and tilted as desired, the mandrel rod, point and guides in place and the rolls spread the right amount, of which more later, the solid billet is pushed by an air cylinder up in contact with the rolls. The rolls grip the billet and draw it spinning up to the piercer point. This spinning or cross rolling apparently forces the metal over the piercer point. However, what actually takes place is not nearly so simple as that. The fact that a rough tube can be made without any point or mandrel being used proves that it is not wholly a piercing of the billet by the point that takes place. The cross rolling applies pressure on the outside metal of the billet. This compression on the outside effects a tension on the inside fibers at right angles to the points of application.

To compare—take a cylinder of rubber and squeeze it on opposite sides. The sides being squeezed come closer together than the diameter of the cylinder while the free sides bulge out, setting up tension in the center fibers and even effecting a crack or split in the center. Now return to the steel billet in the mill, remembering that it is spinning rapidly and that it is in a plastic state. The direction that the tension acts is continually changing, going rapidly through the full 360 deg. and around again and again. This tends to make a hole instead of a crack in the center of the billet, or at least a series of cracks. Furthermore, the angle of the rolls being such that forward motion or feed is set up, the outer layer of steel is pulled forward at the same time. The piercer point may be kept further in the billet than the position at which a hole would be produced without it, but the movement of the metal away from the center has begun and the point meets with comparatively little resistance.

It would seem then that the point actually helps push the metal out, and indeed this is borne out by the condition of the piercer point after the billet has passed completely over it. The tip of the point is gradually burnt away, proving that it has done actual work in forcing the metal out. It is apparent then that this operation is a combination of three distinct forces: first, the cross rolling tending to create a hole in the steel; second, the feed forcing the billet forward through the rolls pulling on the outside fibers and aiding the first force; third, the point held up between the rolls forcing the inside fibers out and aiding the first force.

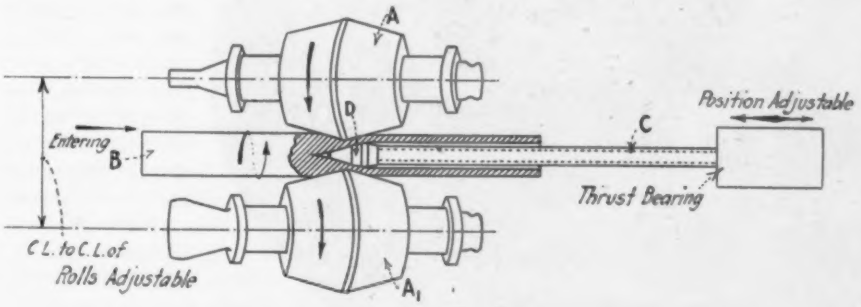



Fig. 1 Shows the Essential Elements of the Piercing Operation, Rotation of the Billet *B* Being Accomplished by Its Friction Against the "Askew" Rolls *A* and $A_1$. The billet is shown partly in section along its center line

The hole made in the end of the billet as described in the centering operation is believed to help start the piercing. It is reasonable to suppose that the metal thus would start away from the center of the billet more readily.

Inside cracks are found in tubes that have been pierced too cold. These are the cracks referred to above, being caused by the breaking away of the metal from the center of the billet and, the steel being below the welding heat, they are not welded up. Of course, being too cold will cause excessive cracking.

Billet *B* is shown in the sketch partly pierced. It feeds clear through until it clears the point and is completely free of the rolls and entirely on the mandrel. The thrust block which backs up the mandrel is arranged to slide away from the mill and the tube is stripped from the mandrel by drawing the mandrel out. The tube is then kicked off onto skids, rolling down for the next operation, the rolling mill. The billet at this point will be a rather rough hollow tube, slightly corrugated on the surface, showing the effect of the spinning and feed, with considerable scale adhering and with more or less rough ends, depending on the wall thickness, which will be considerably heavier than the wall of the tube it is designed to make. Its outside diameter will be approximately the same as the diameter of the billet, although it is possible to pierce either larger or smaller than the billet. It still is relatively short, on account of the heavy wall.

### Variables Which Can Be Adjusted

Variable factors at the command of the operator to produce different size tubes are: first, the diameter of the piercer point, which determines the inside diameter of the tube; the second, the draft, which is the distance between the rolls measured at their largest diameter and in reference to the diameter of the billet. This distance will be about 25 per cent less than the billet diameter. The position of the piercer point longitudinally is adjustable by moving the thrust bearing as indicated in the diagram. The draft and position of piercer point together determine the wall thickness. The farther away from the rolls the piercer point is,

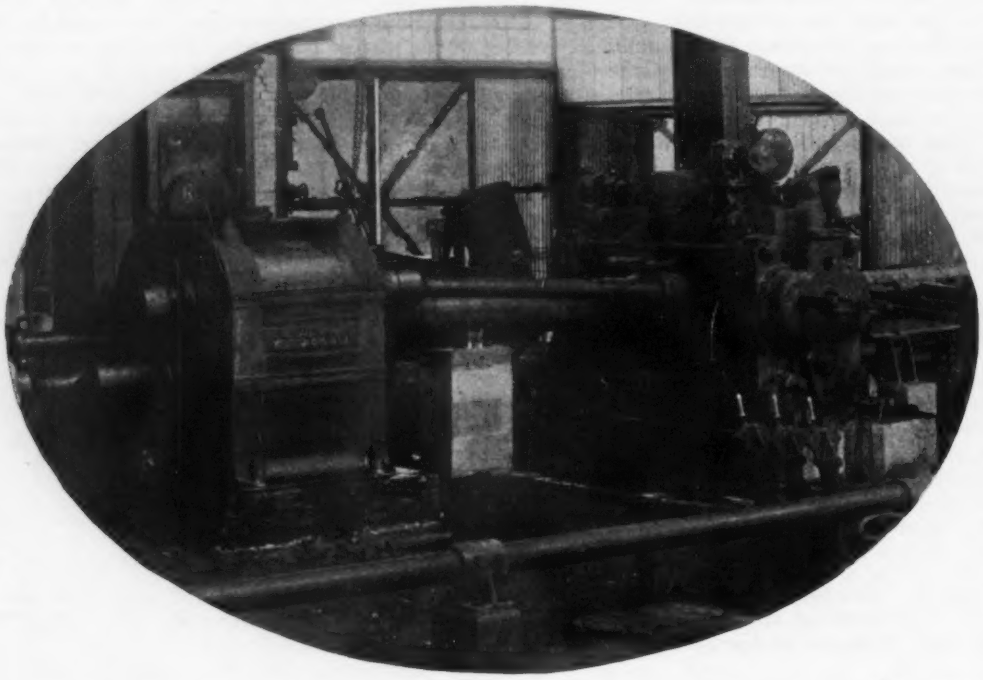
the thicker the wall and the more the rolls are spread, the thicker the wall.

However, there is only a narrow range through which the draft and point may be moved and still keep the piercing operation smooth and easy. There are certainly very well defined limits to this movement. If the rolls are spread too far, they will not grip the billet and feed it through; if the point is too far back, the tube will clear the rolls before it works off the point and the point will remain sticking in the end of the tube. Difficulties of a similar nature are encountered when bringing the rolls too close together and the point too far up.

The position of the point has a large influence on the power consumed. If too far forward, it will be ahead of the point where the metal has started away from the inside of the billet and the operation would more nearly resemble boring than piercing. If too far back, it is away from the position of easy piercing. The experienced operator can tell by the appearance of the piercer point whether the position is right, when it will be cherry red at its tip only.

It is important, then, that the right diameter billet be selected at the start rather than to try to operate the mill with its parts in a wrong position to get the tube desired. The wall of the pierced billet may vary from 3/16 in. in the smaller sizes to 1½ or 2 in. in the larger.

The rolls are steel forgings and will average about 0.60 per cent carbon; their surface may be roughened from time to time to help the feed of the billet. The piercer point is a chrome nickel electric steel casting. The mandrel bars are seamless steel tubing, usually a chrome nickel alloy, and heat treated for toughness and to withstand heat. The guides are iron castings of special mix. The metallurgist has contributed quite as much as the engineer in the development of the modern mill. The main parts referred to must stand up under very severe conditions of heat and wear and the problems of the metallurgist are both difficult and interesting, but it is not within the scope of this article to go further into them.



Piercing Mill at Right with Gear Set at Left, Showing the Inclined Shaft of One of the Mannesmann Rolls. Heated billets are placed in the trough back of the inclined shaft and thence fed into the mill

*(To be concluded)*

## Patent Records Destroyed in Japan

The following information has been received from the Kobe office of the International Trade Developer, Inc., New York:

"It has been confirmed by the Patent Office that all its records of patent registrations, trademark registrations, etc., were destroyed in the fire of Sept. 1. Hence reregistration is necessary. All pending applications for patents and trademarks not yet granted on Sept. 1 should be refilled before Feb. 28, 1924, and patents granted before Sept. 1 should be reregistered before Oct. 31, 1924."

## Peace in the Building Trades in New York

Now that labor and the builders of New York are at peace and by a new pact will probably remain so for at least two years, contractors are inspired to surpass the $750,000,000 record of 1923. Labor leaders asked an increase of $1 to the daily rate of $9, plus a $1 bonus named in the contract expiring Jan. 1, 1923, but compromised with the employers at 50 cents. This increase affects 100,000 men and will raise construction costs in the city $14,000,000, it is estimated.

According to leading architects and builders, the amount of work completed during the two-year term of the contract will be limited only by the available supply of labor. Many projects held in abeyance pending the deliberations of the two groups will now go forward and new plans, it is expected, will be taken up with fresh vigor and without fear of being balked when half finished. Pressure of the demand for new construction is said to be the reason for the contractors conceding a raise.

## Convention of Structural Steel Fabricators

The American Institute of Steel Construction will hold its annual convention at the William Penn Hotel, Pittsburgh, Jan. 23 and 24. Charles F. Abbott, executive director, 370 Madison Avenue, New York, has extended an invitation to attend to all who are directly or indirectly interested in the fabrication of steel for construction whether they are members of the institute or not. The program of the convention will include addresses by several men who are prominent in the business world, and there will be discussions of the problems confronting the structural steel industry. A banquet will be held on the evening of Jan. 23.

An electric locomotive 150 ft. 6 in. long is being built by the American Locomotive Co. for the Virginian Railroad, which will be the most powerful in the world. The wheel base is 137 ft. 10 in.

# 50 Years' Progress in Drilling Machines

## Completion of Half Century of Work in Building Upright and Radial Tools by Cincinnati Company Focuses Attention on Great Strides Made

MOST of our machine-tool companies are of comparatively recent origin, there being few that have spanned the half century that has brought the greatest developments in manufacturing, transportation and science the world has ever known. One of these is the Cincinnati-Bickford Tool Co. of Cincinnati, which this month celebrates its fiftieth anniversary.

In this time it has done its part in America's industrial expansion during a period in which the value of our manufactured products has grown, roughly, from five to more than sixty billions of dollars a year, in which the number of employees engaged in manufacturing has been multiplied by four, or from two and a half to ten million, while capital engaged in manufacturing, which in 1874 was not more than two and a half billion dollars, is now well over forty-five billions.

The Cincinnati-Bickford Tool Co. has kept step with the remarkable strides of America's industries, the changes in the designs of its metal-drilling machinery, as related in this article, affording evidence that our rapid progress in metalworking of all kinds has been due in a large measure to the genius of our machinery inventors and designers in adapting their machines to the special problems created by mass production.

### Business Established in 1874

Henry Bickford, a native of New Hampshire, who had been an employee of J. A. Fay & Co., Cincinnati, started in a small way in 1874 to build upright drills in five sizes, from 20 to 38 in. His business grew steadily and by 1885 he had built and sold 3000 machines. In 1887 the Bickford Tool Co. was organized by Charles Hoefinghoff, president Hoefinghoff & Lane Foundry; A. H. Kerkhoff, who had been foreman for Henry Bickford, and George E. Kerkhoff, who previously was with the Blymer Iron Works, Cincinnati. This company took over the business of Henry Bickford, increased its facilities and gradually developed its manufacturing and designing methods to a point of greater efficiency. In February, 1893, the company was reorganized under the name of the Bickford Drill & Tool Co., Mr. Hoefinghoff remaining as president, August H. Tuechter becoming general manager and Anton Mill engineer and superintendent. Mr. Tuechter, an American of German parentage, had been associated with Mr. Hoefinghoff in various capacities for several years, while Mr. Mill, a graduate of the University of Koenigsberg, had been in this country but a few years and had been a designer for the Cincinnati Milling Machine Co. In 1894 Lewis G. Keck, a Cincinnatian, became secretary and treasurer of the company.

The Bickford Drill & Tool Co. manufactured, in addition to upright drills, a radial drill designed by Mr. Mill. The only other radial drill built in Cincinnati at that time was the product of the Universal Radial Drill Co. In 1886 this business passed into the hands of P. G. March of Cincinnati, who sold it to the Bickford Drill & Tool Co. in 1894.

Mr. Mill was succeeded as superintendent and engineer in 1897 by Henry McCoy Norris, a Cornell graduate, who had served such companies as Bement, Niles & Co., Phoenix Iron Co., John A. Roebling's Sons Co., Ferracute Machine Co., Brown & Sharpe Mfg. Co., Pond Machine Tool Co., Garvin Machine Co., Riehle Brothers Testing Machine Co. and Campbell & Zell Co.

### Cincinnati Machine Tool Co. Organized

In 1896, upon the death of Mr. Hoefinghoff, Mr. Tuechter entered into partnership with Sherman C. Schauer, superintendent for the preceding eight years for the Hamilton Machine Tool Co., Hamilton, Ohio, and they formed the Cincinnati Machine Tool Co., which engaged in the manufacture of upright drills. Meanwhile Harry C. Hoefinghoff had succeeded to the presidency of the Bickford company, with L. G. Keck secretary and treasurer and H. M. Norris superintendent, engineer and works manager. The Bickford company then devoted itself exclusively to the manufacture of radial drills.

Shortly after the death of H. C. Hoefinghoff in 1907, Frederick A. Geier, executor of Mr. Hoefinghoff's will and president of the Cincinnati Milling Machine Co., was elected to the presidency, retaining this position until February, 1909, when the Bickford company was consolidated with the Cincinnati Machine Tool Co., the combined company taking the name of the Cincinnati-Bickford Tool Co. August H. Tuechter became president, S. C. Schauer, vice-president and general manager; George P. Gradolf, secretary and treasurer, and H. M. Norris, mechanical engineer. The new plant at Oakley, Cincinnati, which the company occupied in January, 1911, is probably the largest devoted exclusively to the manufacture of drilling machinery.

### Changes of 40 Years in Drilling Machines

The refinements in drilling machinery which the Bickford company has brought about, in keeping with general advance in machine-tool practice, are forcibly brought out by a comparison of the machines pictured and described in the first catalog of Henry Bickford, issued in 1885, with those today manufactured. In describing the upright drills made by Henry Bickford this old catalog calls attention to the "patent quick re-

AUGUST HERMAN TUECHTER, organizer of the Cincinnati Machine Tool Co. in 1898 and president of the Cincinnati-Bickford Tool Co. since 1909, was born in Cincinnati Aug. 15, 1869. He was office manager for the Bickford Tool Co. from 1887 to 1892; general manager and partner in the Bickford Drill & Tool Co. from 1893 to 1898; business manager and half owner of the Cincinnati Machine Tool Co. from 1899 until 1908, then succeeding to the presidency of the Cincinnati-Bickford Tool Co., when the organization was formed by consolidation of the Cincinnati Machine Tool Co. and the Bickford Drill & Tool Co.

S. C. SCHAUER

HENRY BICKFORD
Founder of the Bickford Business.

H. C. HOEFINGHOFF

SHERMAN CORNELIUS SCHAUER, who was associated with Mr. Tuechter as half owner of the Cincinnati Machine Tool Co., became vice-president of the Cincinnati-Bickford Tool Co. when it was formed in 1909 by consolidation of the Bickford Drill & Tool Co. and the Cincinnati Machine Tool Co. He served in this capacity until his death in 1918. He was born at Hamilton, Ohio, Nov. 13, 1865, and served several companies engaged in metalworking lines previous to his connection with the Cincinnati Machine Tool Co.

HARRY CONRAD HOEFINGHOFF, son of Charles Hoefinghoff, became president of the Bickford Drill & Tool Co. upon the death of his father. He served in the presidency from 1898 until his death on March 2, 1907. He was prominent in the affairs of the National Machine Tool Builders' Association, National Metal Trades Association and National Association of Manufacturers.

turn feed; spindles of steel counterbalanced by weight inside of column; all gears, including back gear and pinion, are cut from the solid; the tables are adjusted to height by rack and pinion, turn in the arm and swing around the column." The spindle in the 20-in. machines of this early type ran at 73, 137 and 260 r.p.m., and that in the 38-in. machine at 52, 83, 120 and 175 r.p.m. They weighed 1000 and 3500 lb., respectively. A particular point in the description of these machines was that "the drill spindle cannot drop when the point of the drill works its way through the iron."

When the Bickford Drill Co. was organized in 1887 radial drills were added to the upright drills hitherto manufactured. The first types were 3 and 4-ft. plain radials and a 4-ft. universal radial in which the head only could be set at an angle. These tools were of the round-column type with driving cone and back gears supported from the base. The spindle in the universal machine was advanced and returned by means of a screw, while those in the plain types were operated through a rack and pinion. The arms raised and lowered by power, the heads were transversed by screws and each spindle was provided with three changes of power feed and eight changes of speed. What these speeds and feeds were is not now known, but the countershafts for all three machines were fitted with 14 x 3½-in. tight and loose pulleys and ran at 180 r.p.m. The 3-ft. radial had a 10-in. column and weighed 4200 lb., while the two 4-ft. radials had 11-in. columns and weighed 5400 lb. each.

Following the reorganization of the Bickford Drill Co. as the Bickford Drill & Tool Co. in 1894, Anton Mill, engineer and superintendent, designed a line of plain radials, the "center of circle" capacity of which was 5 ft. 9 in.; 7 ft. 2 in.; 9 ft. and 11 ft.; also a 5 and 5½-ft. half-universal radial drill and a 4½- and a 5½-ft. full universal radial. He equipped the smallest of the plain machines with a swinging or swiveling table, placed its back gears on the head, graduated its spindle sleeve for reading depths and provided an automatic trip for the spindle. On the larger sizes of plain radials he replaced the head-moving screw with a rack and pinion, incorporated an automatic reversing mechanism and added an auxiliary ring to assist in binding the sleeve to the column. His changes in the universal radials consisted mainly in substituting for the former screw feed a rack and pinion to admit of the spindles being advanced or returned as quickly as the spindle in a plain tool.

### Characteristics of Earlier Radial Drills

The chief characteristics of the radial drills built in Cincinnati by the Universal Radial Drill Co., which was taken over by the Bickford company in 1894, appeared in the drive and column. The countershaft consisted of "a frame with horizontal shaft and T. and L.

*Tables I and II—Developments of 40 Years in Cincinnati in the Regular Type of 6-Ft. Plain Radial Drill*

The general specifications cover various periods, while the column designated Table 2 gives the corresponding data for a 6-ft. machine introduced by the Bickford Drill & Tool Co. in May, 1909.

| Table I 1884 | 1894 | 1901 | 1908 | 1914 | 1923 | General Specifications | Table II 1909 |
|---|---|---|---|---|---|---|---|
| 8 | 9½ | 11 | 11 | 15 | 15 | Arm, width of face, in. | 15 |
| 2½ | 3 | 3 | 3 | 3½ | 3½ | Belt, width of driving, in. | 5 |
| 10 | 15 | 15 | 15 | 15 | 15 | Column diameter, in. | 17 |
| 180 | 200 | 240 | 350 | 425 | 525 | Countershaft speed, r.p.m. | 500 |
| 12 x 3½ | 16 x 3¾ | 16 x 3¾ | 16 x 3¾ | 16 x 4¼ | 16 x 4¾ | Pulley, size of T. & L., in. | 16 x 6 |
| 1 15/16 | 2 7/16 | 2 7/16 | 2 7/16 | 2 7/16 | 2 7/16 | Spindle diameter, in. | 3 |
| 15 | 20 | 19 | 19 | 19 | 19 | Spindle, vertical range, in. | 20 |
| No. 4 | No. 5 | No. 5 | No. 5 | No. 5 | No. 5 | Spindle, bored to Morse taper | No. 6 |
| 8 | 8 | 16 | 24 | 24 | 32 | Speeds, number of | 20 |
| 7–247 | 6–110 | 13–211 | 17–233 | 16–270 | 20–544 | Speeds, range of, r.p.m. | 38–519 |
| 3 | 3 | 8 | 8 | 5 | 5 | Feeds, number of | 10 |
| 6–10 | 6–19 | 7–64 | 5–46 | 6–24 | 6–24 | Feeds, range of | 8–40 |
| 1.17 | 2.18 | 5.99 | 8.73 | 12.36 | 25 | Horsepower at minimum speed | 23.4 |
| 2.54 | 4.36 | 5.99 | 8.73 | 12.36 | 25 | Horsepower at maximum speed | 23.4 |
| 3,800 | 11,000 | 13,200 | 13,800 | 15,500 | 16,000 | Weight, net, lb. | 19,800 |

G. P. GRADOLF

D. C. KLAUSMEYER

H. M. NORRIS

GEORGE PETER GRADOLF, vice-president Cincinnati Bickford Tool Co., was born in Cincinnati Nov. 21, 1875. He was graduated in 1894 from the Technical School of Cincinnati, now a part of the University of Cincinnati, and served his apprenticeship in the shops of the Cincinnati Milling Machine Co. He became assistant to the secretary of the Bickford Drill & Tool Co., then secretary and treasurer of the Cincinnati Bickford Tool Co., and is now vice-president and treasurer.

DAVID C. KLAUSMEYER, assistant general manager of the Cincinnati Bickford Tool Co., was born in New York, Oct. 31, 1882. He was graduated from the Ohio Mechanics' Institute and started work in the shops of the Bickford Drill & Tool Co. Later he entered the drawing room and eventually was put in charge of all designing. He now has charge of production for the Cincinnati Bickford Tool Co.

HENRY McCOY NORRIS, secretary of the Cincinnati Bickford Tool Co., was born at Trenton, N. J., in 1868. He became a stockholder and engineer and works manager of the Bickford Drill & Tool Co. in 1898. He is the designer of the modern type of radial drilling machine.

pulleys and a pair of cut miter gears." . . . "To allow for the difference in height of ceilings a shaft 8 ft. long was furnished, with key seat whole length to connect from countershaft to driving wheel on top of column," which, it was claimed, "will accommodate any ceiling to 15-ft. in height." The driving wheel referred to transmitted the power to a spur gear keyed to a vertical shaft in front of the column, whence the power passed through miters to a four-step cone carried in a frame mounted on the girdle of the arm and thence to a second cone, equipped with back gears, which drove the arm shaft. The column sleeve extended to the base and was "fitted over a stationary stump, bolted fast to the sole plate." This stump, a catalog of that period stated, "has sufficient length of bearing to prevent column from swaying, and is provided with an adjust-

*Table III—Data on 4-Ft. Radial Drills During the Past 30 Years, with the Cutting Speeds and Feeds at Which Drills Were Operated in the Years Indicated*

4-Ft. Radials. Table III

| | 1893 | | | | 1903 | | | | 1913 | | | | 1923 | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Dia. | Revs. | Feed | Feet | Depth | Revs. | Feed | Feet | Depth | Revs. | Feed | Feet | Depth | Revs. | Feed | Feet | Depth |
| 1/2 | 188.7 | .010 | 24.7 | 1.89 | 267 | .018 | 35.0 | 4.81 | 350 | .018 | 45.8 | 6.30 | 692 | .024 | 90.6 | 16.5 |
| 9/16 | 188.7 | .010 | 27.8 | 1.89 | 222 | .018 | 32.7 | 4.00 | 350 | .018 | 51.6 | 6.30 | 608 | .024 | 89.5 | 14.5 |
| 5/8 | 188.7 | .010 | 30.9 | 1.89 | 222 | .018 | 36.3 | 4.00 | 350 | .018 | 57.3 | 6.30 | 563 | .024 | 91.7 | 13.5 |
| 11/16 | 188.7 | .010 | 34.0 | 1.89 | 184 | .018 | 33.1 | 3.31 | 350 | .018 | 63.0 | 6.30 | 506 | .024 | 90.4 | 12.1 |
| 3/4 | 122.5 | .010 | 24.1 | 1.23 | 184 | .018 | 36.1 | 3.31 | 350 | .018 | 68.8 | 6.30 | 461 | .024 | 90.5 | 11.0 |
| 13/16 | 122.5 | .010 | 26.1 | 1.23 | 153 | .018 | 32.5 | 2.76 | 350 | .018 | 74.5 | 6.30 | 412 | .024 | 87.6 | 9.84 |
| 7/8 | 122.5 | .010 | 28.1 | 1.23 | 153 | .018 | 35.1 | 2.76 | 306 | .018 | 70.1 | 5.51 | 362 | .024 | 82.9 | 8.69 |
| 15/16 | 122.5 | .010 | 30.1 | 1.23 | 128 | .018 | 31.4 | 2.31 | 306 | .018 | 75.1 | 5.51 | 330 | .024 | 81.0 | 7.92 |
| 1 | 122.5 | .010 | 32.1 | 1.23 | 128 | .018 | 33.5 | 2.31 | 272 | .018 | 71.2 | 4.90 | 330 | .024 | 86.4 | 7.92 |
| 1 1/16 | 79.5 | .010 | 22.1 | 0.80 | 106 | .018 | 29.5 | 1.91 | 272 | .018 | 75.7 | 4.90 | 298 | .024 | 82.9 | 7.15 |
| 1 1/8 | 79.5 | .010 | 23.4 | 0.80 | 106 | .018 | 31.2 | 1.91 | 245 | .018 | 72.1 | 4.41 | 298 | .024 | 87.8 | 7.15 |
| 1 3/16 | 79.5 | .010 | 24.7 | 0.80 | 106 | .018 | 32.9 | 1.91 | 245 | .018 | 76.2 | 4.41 | 262 | .024 | 81.5 | 6.29 |
| 1 1/4 | 79.5 | .010 | 26.0 | 0.80 | 88 | .018 | 28.8 | 1.58 | 223 | .018 | 73.0 | 4.02 | 262 | .024 | 85.8 | 6.29 |
| 1 5/16 | 79.5 | .010 | 27.3 | 0.80 | 88 | .018 | 30.2 | 1.58 | 223 | .018 | 76.6 | 4.02 | 243 | .024 | 83.5 | 5.83 |
| 1 3/8 | 79.5 | .010 | 28.6 | 0.80 | 88 | .018 | 31.7 | 1.58 | 199 | .018 | 71.7 | 3.58 | 243 | .024 | 87.5 | 5.83 |
| 1 7/16 | 79.5 | .010 | 29.9 | 0.80 | 73 | .018 | 27.5 | 1.31 | 199 | .018 | 74.9 | 3.58 | 218 | .024 | 82.0 | 5.23 |
| 1 1/2 | 79.5 | .010 | 31.2 | 0.80 | 73 | .018 | 28.7 | 1.31 | 175 | .018 | 68.8 | 3.15 | 218 | .024 | 83.6 | 5.23 |
| 1 9/16 | 51.7 | .010 | 21.1 | 0.52 | 73 | .018 | 29.9 | 1.31 | 175 | .018 | 71.6 | 3.15 | 199 | .024 | 81.4 | 4.78 |
| 1 5/8 | 51.7 | .010 | 22.0 | 0.52 | 61 | .018 | 26.0 | 1.10 | 152 | .018 | 64.7 | 2.74 | 199 | .024 | 84.7 | 4.78 |
| 1 3/4 | 51.7 | .010 | 23.7 | 0.52 | 61 | .018 | 28.0 | 1.10 | 152 | .018 | 69.6 | 2.74 | 177 | .024 | 81.1 | 4.25 |
| 2 | 51.7 | .005 | 27.1 | 0.26 | 51 | .018 | 26.6 | .92 | 131 | .018 | 68.6 | 2.36 | 156 | .024 | 81.7 | 3.75 |
| 2 1/4 | 33.55 | .005 | 19.8 | 0.17 | 42 | .018 | 24.9 | .76 | 115 | .018 | 67.8 | 2.07 | 142 | .024 | 83.7 | 3.41 |
| 2 1/2 | 33.55 | .005 | 22.0 | 0.17 | 35 | .018 | 22.9 | .63 | 102 | .018 | 66.7 | 1.84 | 127 | .024 | 83.1 | 3.05 |
| 2 3/4 | 21.8 | .005 | 15.7 | 0.11 | 29 | .018 | 21.1 | .52 | 92 | .018 | 66.3 | 1.65 | 112 | .024 | 80.6 | 2.69 |
| 3 | 21.8 | .005 | 17.1 | 0.11 | 24 | .018 | 19.1 | .43 | 84 | .018 | 66.0 | 1.51 | 104 | .024 | 81.6 | 2.50 |

| | Carbon | | High Speed | |
|---|---|---|---|---|
| | 1893 | 1903 | 1913 | 1923 |
| Total number of speeds | 8 | 16 | 24 | 32 |
| Minimum speed | 9 | 17 | 21 | 26 |
| Maximum speed | 189 | 267 | 350 | 692 |
| Ratio of increase between successive speeds | 1.54 | 1.20 | 1.13 | 1.11 |
| Number of speeds for drills of ½ to 1½ in., inclusive | 3 | 8 | 7 | 12 |
| Average depth per min. of the above advancing by 1/16 in. | 1.18 | 2.39 | 5.04 | 8.88 |
| Ratio between arm shaft and spindle maximum | 1.36 | 2.17 | 8.72 | 9.90 |
| Average cutting speed for drills of ½ to 3 in., inclusive | 25.6 | 29.8 | 68.3 | 85.0 |
| Average cutting speed for drills of ½ to 1½ in., inclusive | 27.7 | 32.1 | 68.6 | 86.3 |
| Relative power of intake belt | 1.00 | 2.95 | 5.55 | 6.86 |
| Depth per minute of a ½-in. drill | 1.89 | 4.81 | 6.30 | 16.5 |
| Depth per minute of a 3-in. drill | 0.11 | .43 | 1.51 | 2.50 |
| Number of speeds for drills of ½ to 3 in., inclusive | 6 | 14 | 13 | 19 |

*Table IV—Data on 24-In. Upright Drilling Machines for the Past 40 Years. The penetration per minute of a ⅞-in. drill in 1883 was 0.66 in., as aganist the present 11.93 in.—a gain of more than 18 to 1*

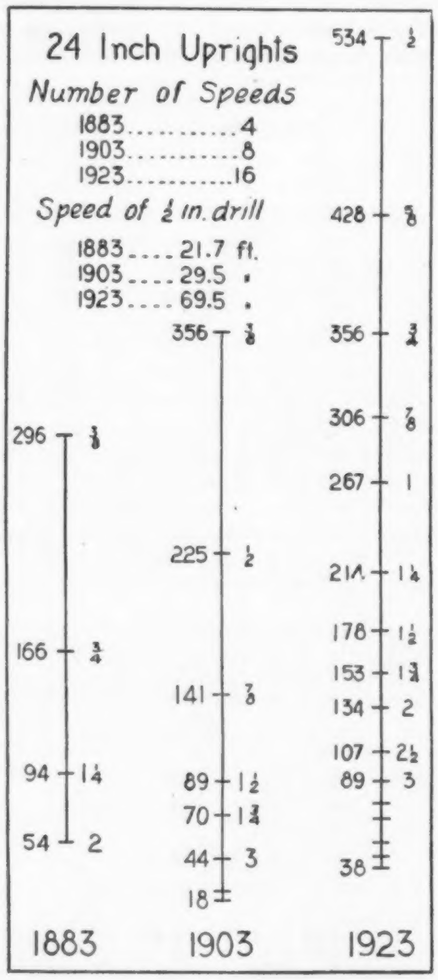
| | 1883 | | | | 1903 | | | | 1923 | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Diam. | Revs. | Feet | Feed | Depth | Revs. | Feet | Feed | Depth | Revs. | Feet | Feed | Depth |
| ⅜ | 296 | 29.1 | .005 | 1.48 | 356 | 35.1 | .006 | 2.14 | 534 | 52.4 | .018 | 9.62 |
| ½ | 166 | 21.7 | .005 | .83 | 225 | 29.5 | .006 | 1.35 | 534 | 69.9 | .018 | 9.62 |
| ⅝ | 166 | 27.2 | .005 | .83 | 141 | 23.1 | .006 | .85 | 428 | 70.0 | .027 | 11.65 |
| ¾ | 166 | 32.6 | .005 | .83 | 141 | 27.7 | .006 | .85 | 356 | 69.9 | .027 | 9.62 |
| ⅞ | 94 | 21.5 | .007 | .66 | 141 | 32.3 | .009 | 1.27 | 306 | 70.1 | .039 | 11.93 |
| 1 | 94 | 24.6 | .007 | .66 | 89 | 23.3 | .009 | .80 | 267 | 69.9 | .039 | 10.41 |
| 1¼ | 94 | 30.8 | .007 | .66 | 89 | 29.1 | .009 | .80 | 214 | 70.0 | .039 | 8.35 |
| 1½ | 54 | 21.2 | .007 | .38 | 89 | 34.9 | .009 | .80 | 178 | 69.9 | .027 | 4.81 |
| 1¾ | 54 | 24.7 | .007 | .38 | 70 | 32.1 | .013 | .91 | 153 | 70.1 | .027 | 4.13 |
| 2 | 54 | 28.3 | .007 | .38 | 44 | 23.0 | .013 | .57 | 134 | 70.2 | .018 | 2.41 |
| 2½ | ... | ... | ... | ... | 44 | 28.8 | .013 | .57 | 107 | 70.0 | .018 | 1.93 |
| 3 | ... | ... | ... | ... | 44 | 34.6 | .013 | .57 | 89 | 69.9 | .013 | 1.16 |

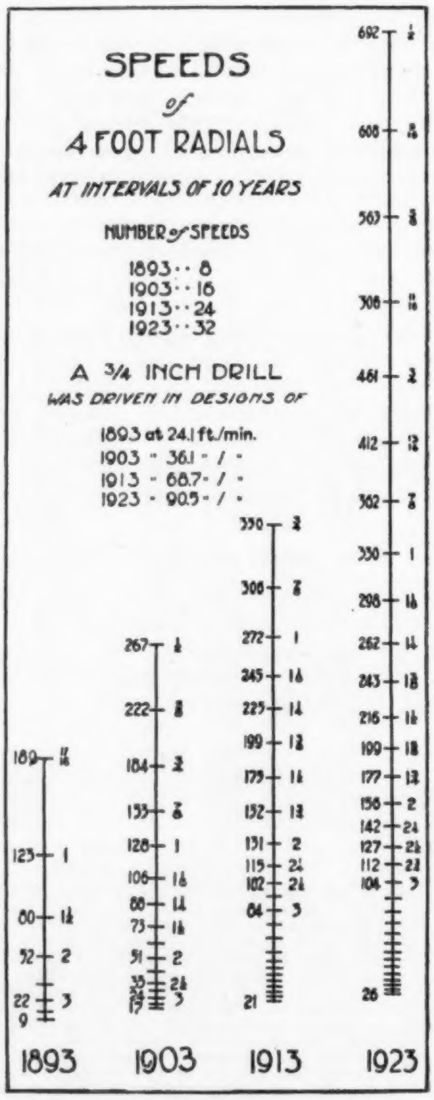
| | 1883 | 1903 | 1923 |
|---|---|---|---|
| Belt, width of | 2½ | 2½ | 3½ |
| Countershaft, speed of | 250 | 400 | 427 |
| Driving pulley, diameter of | 10½ | 11 | 12 |
| Spindle, diameter of | 1 7/16 | 1 9/16 | 1 9/16 |
| Spindle, bored to Morse Taper | No. 3 | No. 4 | No. 4 |
| Feeds, number of | 2 | 6 | 6 |
| Feeds, range in thousandths | 5–7 | 6–39 | 6–39 |
| Speeds, number of | 4 | 8 | 16 |
| Speeds, range of | 54–296 | 18–356 | 38–534 |
| Speeds, number for drills of ⅜ to 2 in | 4 | 6 | 9 |
| Horsepower of belt at minimum speed | 1.46 | 2.85 | 9.30 |
| Horsepower of belt at maximum speed | 3.41 | 5.71 | 9.30 |
| Weight, net, lb | 1,500 | 1,825 | 2,200 |

able pivot bearing upon an elastic diaphragm in the column, which, when the bolts in flange at the lower end of the column are slackened, takes the weight of the machine off the flange bearing and allows the column, with arm, etc., to revolve easily the entire circle."

Meanwhile extensive developments were being made in upright drills by the Cincinnati Machine Tool Co. Included among these were the improvements effected by Mr. Schauer in his friction back gear, positive geared feed box, geared tapping attachment and worm wheel elevating mechanism. This company was the first also to bring out the modern, high-speed, shaft-driven upright, which won gold medals at the Pan-American and West Indian Expositions, 1901 and 1902; Universal Exposition, Liège, Belgium, 1905, and International Exposition, Milan, 1906.

The Bickford Drill & Tool Co. also made many advances in design of radial drills, among the most noteworthy, conceived by Mr. Norris, being an arm made in pipe section and one that lowered at double its elevating speed and was provided with means to guard



against being set in motion by accident; an automatic trip which permitted full spindle travel while serving as a safety stop; a back gear that furnished four changes of speed; a depth gage that read from zero; a geared feed box that gave instantly eight changes of feed and a speed box which, with the back gears, furnished, 16, 20 or 24 changes of spindle speeds.

**Further Improvements in Recent Years**

Among the many improvements made in the radial drill since the consolidation which resulted in the formation of the present Cincinnati-Bickford Tool Co. in 1909, may be mentioned the substitution of bronze for babbitt; the introduction of the narrow guideway for the head, with a greatly increased surface-in-contact between it and the arm; a head-moving mechanism fitted with ball bearings; a back gear level located so as to be operative from the bottom of the head; an arm interlock to prevent its being set in motion while clamped; a column binder in which the sleeve is locked directly to the inner trunk, either by a level on the girdle of the arm, one at its outer end or by compressed air controlled from the head; an arm in which the ribbing is of box section and gearing that is made of steel carbonized and hardened.

Developments in the design of the regular type of 6-ft. plain radial drills during the past 40 years in Cincinnati are set forth in Table I, while in Table II corresponding data are given for a 6-ft. machine introduced by the Bickford Drill & Tool Co. in May, 1909. The contrast between it and the tool of 1884 is most interesting. According to present knowledge of the subject, the earlier machine would be taxed to its limit in driving a 3-in. drill in machinery steel at 13 revolutions (10.2 ft. cutting speed) and 0.007 feed, while the later one drives, without apparent distress, a 3-in. drill in steel at 127 revolutions (100 ft. cutting speed) and 0.025 in. feed.

Table III gives data on 4-ft. radial drills during the last 30 years, with the cutting speeds and feeds at which drills were operated in the years indicated. Table IV covers similar data on 24-in. upright drills for the past 40 years, in which it will be noticed that the penetration per minute of a ⅞-in. drill in 1883 was but 0.66 in. as against the present 11.93—a gain of more than 18 to 1. The relative increase in cutting speeds is depicted in graphic form.

In 1909 the Bickford company brought out a high-speed drill, the speed range being from 38 to 519 r.p.m. as against 17 to 233 r.p.m., the highest then in use on a 6-ft. radial; no gears on this machine ran at a peripheral speed greater than 960 ft. per minute, as against 1038 ft.; and the machine drove a 1¼-in. drill in steel at 425 revolutions (139 ft.) and 0.02-in. feed, as against 107 revolutions (35 ft.) and 0.013-in. feed, without indication that it was doing anything out of the ordinary.

The Bickford company in 1901 used a speed box for the first time on any machine, and this development was referred to at that time as the first step in the abandonment of cone pulleys for different driving speeds; it also invented the speed change mechanism used on automobiles, obtaining four speed changes with seven gears; it established a precedent by breaking away from the Morse feeds of 0.005, 0.007 and 0.010 in drilling operations, and in this connection it is of interest that the Morse Twist Drill Co. in 1902 placed an order with the Bickford company for a special machine to test drills, this machine having 36 speeds, ranging from 31 to 267, and 24 feeds, ranging from 0.00335 to 0.035, showing what were considered the outside limits in those days.

# Finished Steel Market vs. Pig Iron

## Violent Fluctuations of the Raw Material Sometimes Copied in Miniature by Finished Product—Recent History Shows the Two Following Entirely Separate Courses

IT has long been recognized by economists that prices of raw materials undergo greater fluctuations than those of products nearer to the ultimate consumer. Conversely, as most personal needs must be satisfied, regardless of market conditions, those products sold directly to the final user show less fluctuation, both in price and in quantity of production, than do the raw materials. The "feast or famine" history of the pig iron market, while sometimes reproduced (on a smaller scale) by finished materials, is neither so hearty a feast as in the latter case nor is the famine so serious. This applies particularly to prices, although production also follows this general rule in some degree.

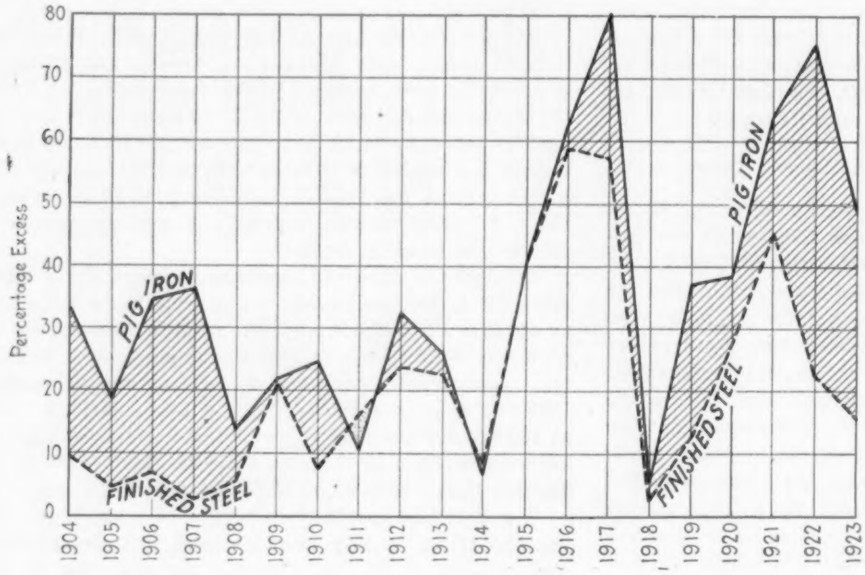
Two diagrams herewith bring out this fact of price divergence between the two groups of product—the raw and the finished—in striking form. In the one case we have, week by week, THE IRON AGE composite prices of pig iron and of finished steel for the past three years. In the other case we have a diagram covering 20 years and showing the relation of the highest price of each year to the lowest price of that same year with regard both to pig iron and to finished steel.

In only two years of the 20 was the fluctuation of the finished steel greater than that of the pig iron, and in each case the movement was slight in both materials. Thus, in 1911, finished steel showed a maximum variation of 16.3 per cent against 10.2 per cent for pig iron. In 1914 finished steel showed 8.1 per cent variation against 6.4 per cent for pig iron. In all other cases the pig iron fluctuation was greater than that of finished steel and in many cases it was at least three times as great.

In the diagram showing the percentage excess of the year's highest price over the year's lowest price, the area designated by diagonal section lines indicates a greater fluctuation of pig iron than in finished steel. On the other hand, the two small areas shown dotted in 1911 and 1914 indicate the reverse condition. The disproportion between the two different forms of area is so evident from the diagram that it requires no argument.

In the other diagram, showing the weekly course of the pig iron and finished steel composite prices, both plotted in dollars per gross ton, the most striking divergences are that shown in the fall of 1922 and that appearing all through the spring, summer and fall of 1923. In each case the price of pig iron showed a sharp and persistent drop, with only occasional interruption, while in both cases finished steel showed a steady and almost uniform price level. This was particularly accentuated this year, there having been only one slight adjustment of the steel price since the first week of May.

There are other differences between the two markets, however, which are not quite so apparent to the casual eye. For instance, in 1921 the pig iron market



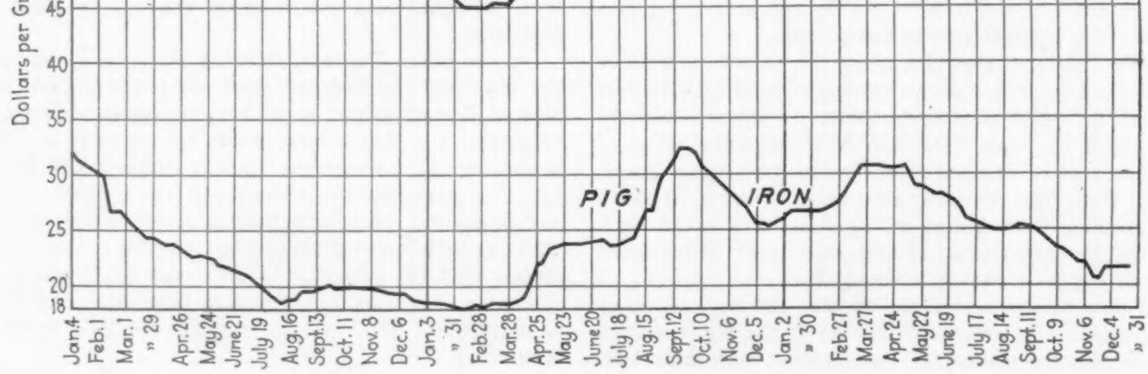

Percentage Excess of Year's Maximum Quotation Over Year's Minimum Is Shown for 20 Years. In only two cases, both in years of slight fluctuation, was finished steel variation as great as that in pig iron. The cross-hatched area, showing excess of pig iron fluctuation, indicates the impossibility of gaging market conditions adequately by lumping together (as is done in some published indices) products which are totally dissimilar

reached bottom early in August and thereafter pursued an almost uniform course for eight months. Finished steel did nothing of the sort. Bottom was not reached until February, 1922, and recovery in the price began almost immediately.

Again, in the fall of 1922 finished steel reached a high level late in August—about a month before pig iron reached its high level. Although the finished steel went higher a few weeks later, yet the variation between Aug. 22 and early January was small, whereas pig iron, due to conditions in that market too recent and too well known to require discussion, dropped sharply through the fall of the year, showed a heavy upgrade in the early months of 1923 and now has fallen almost interruptedly since early May.

This was due in large measure, of course, to the bituminous coal strike, which curtailed the output of coke and shut down many blast furnaces, creating a shortage of pig iron (with consequent rising of prices), and thus causing its importation. Meantime steel was being made without much disturbance from the strike and prices were not severely affected.

Many instances could be cited showing the great divergence between the courses of these two markets, but enough has been pointed out to show that they cannot safely be considered as a unit. The influences at work back of the one differ so markedly from those affecting the other that it would be wholly unreasonable to expect them to move together—if we except the great cyclical movements of commodities as a whole, registering the peaks and depressions in the history of American business.




Weekly History for Three Years of the Variation in Pig Iron and Finished Steel Prices. The total dissimilarity of the curves since last April is striking

## 1923 Set a Hard Pace for 1924

(*Continued from page 3*)

about 50,000 tons for the first six months, while in November it was only 9299 tons. The exports for 1922 amounted to 30,922 tons and for the first 11 months of 1923 the total was 27,786 tons.

In the long decline in pig iron, merchant blast furnaces had some compensation in a reduction in their fuel cost. Coke was in active demand in the early part of the year, as blast furnace operations increased, and for first and second quarter shipment commanded $7 at ovens. There was some buying of coke also for shipment to Europe, in view of the Ruhr embargo. But later as pig iron output fell off coke declined and early contracts for first quarter (1924) furnace coke were placed at $4.25 to $4.40, while the present expectation is that $4 will be done on much of the coke yet to be bought for that delivery.

### The Course of Steel Prices

Turning now to finished steel, we find, as was indicated above, that the price curve for the year followed a very different course from that taken by the pig iron curve. THE IRON AGE'S price charts, found on later pages, show that year after year there has been, with some minor variations, a general parallelism in the pig iron fluctuations and those for the various forms of rolled steel. In 1923 the seven months' decline in pig iron, beginning in April, was attended by no material change in the prices of the leading finished steel products. The diagram on page 3 shows particularly the steadiness in the average prices of plates, shapes and bars, the three heavy products which together represent 40 per cent of all the rolled steel.

In the first three months of the year the policy of consumers of steel was to make sure of all the steel they were likely to need for some months ahead. Naturally under such an impulse prices advanced and premiums were paid, as indicated by 2.75c. and higher for early delivery of plates, shapes and bars, as against a 2c. market at the beginning of the year. In our market review of March 15 it was said that the price advances were due in many cases to efforts of buyers to increase their stocks of steel or to insure a supply that would give them uninterrupted operation. However, as was shown later, there was very little duplicate buying of the sort that stood out in the slump of 1920.

The Steel Corporation, which with its great capacity must always have a full order book for a good distance ahead, had sold freely all the way from the 1.35c. plates, shapes and bars of early 1922 to the 2c. level reached at the end of that year. By the latter part of February these three products had advanced to 2.25c. as a minimum, but the Steel Corporation had been able to take relatively little business above 2c. because of its heavy commitments. In March and early April, when the Steel Corporation could take on additional tonnage for second quarter or early third quarter delivery, its prices were from $4 to $6 a ton above the 2c. level, but it made no announcement of its prices such as had been made at times in 1921 and early 1922. However, in the third week of April it did make several definite advances, putting bars to 2.40c. and plates and shapes to 2.50c., or $2 a ton more than the basis of its last preceding sales of those products. At the same time it put wire products up $2 a ton, or to 2.75c. for plain wire and $3 a keg for nails.

While these prices for plates, shapes and bars were $5 to $7 a ton below what independent steel producers had been getting for early shipment, only a few weeks had passed before premium prices had largely disappeared. In fact, it was stated in our market summary of May 10 that independent steel companies that only a short time before were out of the market began taking third quarter business, and at prices close to those of the Steel Corporation.

#### PLATE, SHAPE AND BAR PRICES HELD

For more than eight months, 2.40c. for bars and 2.50c. for plates and shapes have been maintained by nearly all producers in the face of a declining market for pig iron. There have been sales of all the products named at concessions of $2 a ton, but these have been sporadic reductions and not made by the larger producers. On the one hand there has been for some months the expectation of consumers that prices would be reduced, seeing that demand had fallen off somewhat from the rate of the spring months and that 2.40c. and 2.50c. prices represented an advance of $10 to $15 a ton upon the average paid for the steel shipped to various manufacturing consumers in 1923. On the other hand, all through the second half of the past year steel producers have held the opinion that concessions would not increase the volume of buying, seeing that consumers considered they were in a declining market. Producers also had proof of consumption on a large scale in the fact that as a rule buyers were taking in steel at the full contract rate.

Indications were that consumption of steel did not fall off between April and December to any such extent as production. The latter declined nearly 25 per cent from the peak. But in the first part of the year buyers took more steel from the mills than they currently used and thus there was some building up of stocks in the hands of jobbers and manufacturing consumers. In the second half there was evidence that manufacturing consumers and jobbers drew on their stocks. Thus at the end of the year there were no large stocks in intermediate or final hands.

#### WEAKNESS IN SOME PRODUCTS

In modification of what was said above as to the maintenance of finished material prices through the year, it should be noted that some products showed more variation than was apparent in plates, shapes and bars. There was weakness in sheets, in cold-finished steel bars, in hoops, bands and strip steel, as also in bolts, nuts and rivets. But concessions in wire products, pipe and tin plate were exceptional and without effect on the general market.

The enormous plate demand of the first quarter, due to large requirements for cars, locomotives and oil and other tank work, soon filled up the Chicago, Pittsburgh and Youngstown mills, resulting in an overflow to Eastern mills. In February and March some of the latter were taking orders for shipment to points as far west as Chicago and Milwaukee, while shipments into the Pittsburgh and Cleveland districts were common. In March premiums commonly were paid to the Eastern mills for early shipments, taking the plate price as high as 2.75 cents and even 2.85 cents. Similar conditions prevailed in structural shapes, by which the smaller mills in the East prospered for a few months on premium business. In the third quarter these same mills were so hungry for orders that they made concessions of $2 or $3 a ton (which were not met by the larger producers), and even then were unable to maintain a satisfactory operation. During the last quarter the average operation of Eastern plate mills did not get above 50 per cent and much of the time was considerably below that.

A number of changes in extras were made in 1923, mainly advances, notably extras applying to cold-finished bars and to certain bar sizes. Sheet, tin plate and wire extras were also revised upward.

Coincident with the rise in pig iron and steel prices

in the first three months of 1923, all descriptions of old material had a steady upward tendency. Steel scrap delivered at Pittsburgh advanced from $21, at the beginning of the year, to $27 in the latter part of March. Other grades moved up proportionately. The decline was gradual, starting in April and continuing until August, when there were slight advances in all markets, followed by further weakness which continued until steel scrap had gone to $15, Pittsburgh, in October. The last two months of the year brought renewed activity and rising prices, which at the beginning of 1924 are only $1 or $2 under those of one year ago.

### Eight-Hour Day Marks an Epoch

The past year was made epochal in American steelmaking annals by the abolition of the 12-hour day at the plants of the leading steel companies. It cannot be said as yet that the long turn has been eliminated, for various lesser companies are still working their plants on two shifts, but the number of men now employed 12 hours a day is relatively small and in 1924 it may become really negligible.

Though long mooted, the actual elimination of the two-shift day dates back to a conference which the late President Harding had on May 18, 1922, with 40 representative steel manufacturers. At the President's request the conference appointed a committee to consider the subject and to report to the American Iron and Steel Institute. The report was read by Judge E. H. Gary at the institute meeting of May 25, 1923. Its conclusion was that while the committee could not at that time report in favor of the total abolition of the 12-hour day, it might do so later if labor supply were sufficient and if consumers of steel and industry at large favored the change.

On June 18, President Harding wrote Judge Gary, the committee's chairman, asking if the steel companies would agree that in case of any recession in demand they would change so far as possible from two shifts to three shifts. The directors of the American Iron and Steel Institute then met and the 15 present joined in a letter to the President promising to make every effort to eliminate the 12-hour day as fast as a surplus of labor became available.

The first move on a large scale was made by the Carnegie Steel Co., which on Aug. 16 put its coke ovens, blast furnaces, and steel plants on the 8-hour basis. In the same week and the week following most of the plants in the Youngstown district, also those of the Bethlehem Steel Corporation, changed from the 12-hour to the 8-hour day.

The wage basis was the difficult problem. The 12-hour men who had been receiving 40c. an hour were given 50c. an hour when they went to eight hours. This was a 25 per cent increase in the hourly rate, but the day's wage became $4 as against $4.80 previously. At first the wages of the 10-hour men were not changed, but on Sept. 7 Chairman Gary of the Steel Corporation and President Grace of the Bethlehem Steel Co. made announcements of an increase of 10 per cent in the hourly rate of the 10-hour men, giving them $4.40 for a day's pay. Other companies made a like advance.

At the October meeting of the American Iron and Steel Institute Judge Gary congratulated the membership on the elimination of the 12-hour day. The process involved many adjustments, as is indicated in an article on other pages.

While it had been said that the 8-hour shift meant an increase of $2 to $3 a ton in the cost of making steel, there is no basis as yet for any general statement of the advance in cost. In certain departments, particularly blast furnaces, some companies have made the change with little or no increase in the number of workers. The labor supply has been such, with the gradual recession in the volume of steel business, that the workers have been willing to share with their employers the cost of the shorter day. It is not overlooked that there will not be the same willingness to continue to accept the reduced day's pay when the operations are again at a rate causing competition for men between steel works and other industries.

Apart from the advances made in connection with the eight-hour day, iron and steel works labor received one increase in 1923. On April 9th the Steel Corporation announced an 11 per cent advance in wages in the manufacturing plants of its subsidiaries, bringing common labor up from 36 cents an hour to 40 cents an hour. Similar advances were made by other steel companies.

### Exports and Imports

The volume of American steel exports in 1923 was substantially a duplicate of that for 1922, the total for each being within a few thousand tons of 2,000,000. Early in the year there was an expectation of some business with Europe due to the French invasion of the Ruhr and the cutting off of shipments from the occupied section of Germany. But such hopes had no real foundation. It became plainer, as conditions in central and southeastern Europe grew worse, that the promise of export trade for this country in iron and steel products lies largely in other directions—with Canada, South America, Japan and China. Tin plate exports last year were about 120,000 tons, a 50 per cent increase over 1922. Sheet exports fell off in a marked degree, until Japan began buying here to repair the wreckage of the great earthquake of early September. In the past few months Japan's purchases, in this country, chiefly sheets, wire products and rails, have been about 70,000 tons. Later will come some demand for structural steel for rebuilding, but it will not be large. Throughout the year Japan has been a buyer of American steel rails, and the year's shipments of rails to Japan have amounted to about 90,000 tons.

In all rolled steel products the export movement of the year probably represents about 6 per cent of the domestic production of steel, whereas in the years 1912-1920 inclusive about 10 per cent of our steel production was sent abroad.

Machinery exports ran nearly 20 per cent more in 1923 than in 1922, and the total for the year was not far from $275,000,000.

The following table shows how the 1923 export shipments of iron and steel products which are stated in the statistics in tons compared with those of previous years:

*Exports of Iron and Steel, Gross Tons*

| | 1919 | 1920 | 1921 | 1922 | 1923 |
|---|---|---|---|---|---|
| January .. | 360,456 | 333,601 | 547,394 | 160,920 | 123,190 |
| February . | 234,793 | 308,185 | 393,328 | 133,975 | 133,902 |
| March .... | 344,506 | 417,216 | 230,635 | 208,843 | 163,920 |
| April ..... | 408,204 | 395,120 | 162,592 | 198,830 | 177,471 |
| May ..... | 447,050 | 420,359 | 142,551 | 230,062 | 203,389 |
| June ..... | 544,580 | 402,707 | 119,081 | 212,295 | 171,183 |
| July ..... | 287,823 | 458,866 | 86,523 | 157,169 | 168,558 |
| August ... | 396,743 | 431,484 | 75,827 | 145,640 | 161,426 |
| September. | 363,505 | 409,200 | 95,169 | 129,475 | 172,499 |
| October .. | 302,456 | 452,015 | 106,582 | 132,924 | 152,511 |
| November. | 295,045 | 434,297 | 122,290 | 127,782 | 186,956 |
| December. | 254,676 | 498,765 | 134,415 | 150,170 | ...... |
| | 4,239,837 | 4,961,815 | 2,213,042 | 1,988,085 | 1,995,000* |

*Estimated.

### Steel Company Earnings

While net earnings of steel companies in the past year make favorable comparison with those of 1922, the fact that stands out is the decreasing margin of profits per ton. After operating from 85 to 90 per cent of capacity during the third quarter, the United States Steel Corporation showed net earnings of $47,053,680 (about $13 per ton) making nine-months' earnings of $129,691,930. September earnings fell nearly 3 millions below those of August, showing the

first effects of the eight-hour day. However, unless there is a sharp drop in the fourth quarter, net earnings for the year will not be far behind those of 1920, which were $177,174,126. It is noteworthy that labor's share of the Steel Corporation's dollar of gross receipts has risen from 30.5 cents in the period of 1902-7 to 43.4 cents in the period 1920-22. As of Jan. 1, 1923, the corporation's cash and security holdings totaled $324,536,809.

The Bethlehem Steel Corporation was unable to take full advantage of the improvement marketwise. Much effort was shunted into amalgamating the newly acquired Midvale properties and earnings for the first quarter did not cover dividend requirements. In the second and third quarters, net earnings totaled $22,-119,633, showing a margin over dividends. Surplus for the third quarter was $1,074,655, for the June quarter $2,102,262. Against a deficit for the first nine months in 1922 of $764,376, the Republic Iron & Steel Co. showed net profits for that period in 1923 of $5,434,-185. Net profits of the Youngstown Sheet & Tube Co. for the first nine months of 1923 were $14,689,899. The Inland Steel Co. showed net income, after depreciation and charges, of $3,731,356 in the nine months against net, after charges, of $1,141,177 in 1922.

#### Consolidations and the Government

The Bethlehem Steel Co., which in 1922 took over the Lackawanna Steel Co. and a few months later completed arrangements for acquiring the Midvale Steel & Ordnance Co. properties except those at Nicetown, Pa., formally took over the Midvale and Cambria properties on March 30, 1923. The Federal Trade Commission issued a complaint on Jan. 27, alleging that the Lackawanna and Midvale acquisitions were in violation of section 7 of the Clayton act. Hearings on this complaint were held from time to time throughout the year, buyers of steel in various centers being called on to testify as to the effect of the mergers on competition among steel producers. The matter is still pending and may later take its course in the Federal courts.

In January the taking over of the Brier Hill Steel Co. properties at Youngstown, Ohio, by the Youngstown Sheet & Tube Co. was formally carried out. In February the Youngstown Sheet & Tube Co. arranged to acquire the Steel & Tube Co. of America, whose principal properties are in the Chicago district. Some stockholders in the latter company temporarily restrained the purchase by a court action, but later the injunction was dissolved and the purchase was carried out early in July. Officers of the Youngstown Sheet & Tube Co. announced that by this acquisition the company became "the third largest steel producing concern in the United States."

There are indications that the consolidation movement in steel may go further, reports that had currency in the latter part of the year pointing to a well-known company in the wire trade as likely to be acquired by one of the larger steel interests.

#### The Pittsburgh Basing Case

As 1923 drew to a close the last bit of testimony was taken at Washington in the famous Pittsburgh basing case against the United States Steel Corporation, long pending before the Federal Trade Commission. It is believed that the commission's decision will not be given for at least six months. After that there is the possibility of two or three years of court proceedings.

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# Another Active Year in Cast Iron Pipe

CAST iron pressure pipe has seen a year of more than usual activity in 1923, as was also 1922. A fair volume of demand from private water and gas companies was carried over from the previous month into January and calls for bids from many municipalities began to appear during the first month of the year. With many makers, January was a bigger month in point of tonnage shipped than January, 1922. By the end of February, many makers were booked ahead for from three to four months on the smaller sizes of pipe and in the Chicago district, demand was declared by some sellers to be almost without parallel in the history of the market. During this time, private purchasing had continued heavy and had been gradually supplemented by the increasing number and size of tenders from municipalities.

It was claimed by some sellers into the New England district that more business had been accepted in that section than in any similar period in the history of the industry. Deliveries on these orders, however, were uncertain, as a result of the numerous railroad embargoes. By the end of March a number of makers were booked ahead from four to five months on the smaller sizes. There was at this time some foreign inquiry but foundries were so well supplied with domestic orders that most of it aroused but little interest. This situation was repeated at the end of September and early in October when, as a result of the earthquake in Japan, a few feelers on prices of water pipe for immediate shipment aroused little or no response from makers, who were booked well toward the end of the year and unable to make the prompt shipments desired.

It was estimated by some sellers that shipments to the Pacific Coast alone, had totaled 100,000 tons of pressure pipe during the first half of the year, largely from Southern makers. The usual difficulty in obtaining and holding labor was encountered as warm weather set in and inability to obtain early delivery coupled with a declining pig iron market was doubtless the cause of delay of purchase by many potential buyers. The Southern pipe makers were probably more affected by the weakness of the pig iron market than the Northern foundries.

Some European competition was felt on the Pacific Coast during the latter months of the year, 4000 tons of pressure pipe for Los Angeles, Cal., being awarded to a French foundry at Pont-a-Mousson, at a price from $1 to $2 under the domestic bids, later Pasadena, Cal., placing 1000 tons with a French company. On a tonnage of 20,500 tons of water pipe for Porto Rico, a vigorous effort was made by American makers to obtain the business. At two openings of bids, the first having been declared void, an importer in Porto Rico, representing a Belgian maker was low bidder.

Progress was reported during the year by the United States Cast Iron Pipe & Foundry Co. and the National Cast Iron Pipe Co., on further installations of the DeLavaud process.

Prices were firm throughout the year, in most instances registering a gradual rise, in spite of a weak pig iron market through the summer and early fall, holding up until well into the latter weeks of the year. While maintaining quotations for prompt and spring delivery, some makers offered concessions as winter approached of from $1 to $3 per ton to purchasers willing to accept winter delivery.

As undoubtedly many pipe users, gas and water companies, municipalities and other buyers were unable to obtain early enough delivery for 1923 requirements, a continuation of acivity is expected by pipe makers to mark the early months of 1924.

# Pig Iron and Steel Output of the World

## Two Pre-War and Five Post-War Years Compared—Steel Production Exceeds 1913—Exports Still Below Pre-War

BY EDWIN F. CONE

AFTER five years of activity since the close of the great war, the iron and steel industry of the world can not yet be characterized as normal. Using the five leading producing nations as representing the world's industry, normal conditions were gradually being restored but in only one or two can it be said that normalcy prevails. The year 1913 is used as representing normal relations.

When the war closed, five years ago, there were predictions of tremendous peace demand for iron and steel because the world was considered far behind in the normal or peace consumption of steel products. An analysis of world production and trade in steel and iron a year ago showed that this prophecy was a dream. After another year has passed, a similar analysis shows that the world has traveled considerably further toward a more normal consumption and production of iron and steel. For the first time since the war the world's steel output exceeds that of 1913, and that by over 2,000,000 tons, but the production of pig iron is still considerably less than it was before the war. In world demand for steel, as represented by exports, the discrepancy between last year and the year before the war is still considerable.

## Output and Exports of the Five Leading Countries

FIVE countries produce most of the world's pig iron and steel: United States, Great Britain, Germany, France and Belgium. Canada and Luxemburg are, of course, important, but these two countries in 1913 produced only about 3,500,000 tons of pig iron and about 3,750,000 tons of steel and their production for 1923 will not materially alter their relations. The data on which the following analysis is based are taken largely from those published by the National Federation of Iron and Steel Manufacturers (British). The record of each country is briefly discussed first and then that of the five countries as a whole. Under "steel" is included castings and scrap is not included in the exports.

### The Industry in the United States

The course of the American iron and steel industry is discussed in detail elsewhere in this issue. In production the outstanding feature is that the pig iron output last year exceeded any war or peace record and that the steel output, while not equalling one of the great war years, was very close to it and at the same time exceeded any other year before or since the war. An interesting feature is that the spread between the pig iron and steel output last year was much smaller than in 1922 or 1920 but still larger than in the two years preceding the war.

*American Iron and Steel Output and Exports During Peace Years in Gross Tons*

| United States | Pig Iron | Steel | Exports |
|---|---|---|---|
| 1912........ | 29,727,000 | 31,251,000 | 2,418,000 |
| 1913........ | 30,966,000 | 31,300,000 | 2,892,000 |
| 1919........ | 31,015,000 | 34,671,000 | 4,399,000 |
| 1920........ | 36,926,000 | 42,133,000 | 4,706,400 |
| 1921........ | 16,688,000 | 19,784,000 | 2,172,000 |
| 1922........ | 27,220,000 | 35,603,000 | 1,986,300 |
| 1923........ | 40,250,000* | 44,650,000 | 1,995,000† |

*December estimated. †November and December estimated.

A conservative estimate of the country's steel output is 44,650,000 tons, of which 43,250,000 is ingots and 1,400,000 tons is castings. The ingot production is about 370,000 tons less than in the war year 1917, and the estimate of the steel casting output is about the same as the production rate in the last two years of the war. It is possible that figures issued about the middle of 1924 by the American Iron and Steel Institute may show a larger production of steel castings as it is known that the industry has been operating at a high rate. Both the pig iron and steel output for last year, however, exceeds the record of any peace year and is conclusive demonstration of the nation's tremendous powers of consumption.

As shown by the table, the country's record in exports is not an enviable one. At 1,995,000 tons last year, sales of iron and steel to foreign consumers is the lowest in any year in the last twelve. This is only about 67 per cent of the volume in 1913 and only a little over 40 per cent of the record exports in 1920. The American record last year is in strong contrast with that of the British, where the trend last year was constantly upward, attaining a volume at the end of the year of over 90 per cent of the 1913 record.

### The Industry in Great Britain

An unusually interesting record was made last year by the British steel industry. While the trend was upward, practically throughout the year in both pig iron and steel output and in exports, the expansion in each case differed considerably in degree. Domestic conditions were not so favorable as they might have been, but undoubtedly the French occupation of the Ruhr turned out to be beneficial on the whole to the British industry, cutting down as it did to a large degree the German output, and handicapping, at least in the early part of the year, that of both France and Belgium. The British industry last year in iron and steel output did not break any records, although the upward advance, which started from the low point in 1921 and continued in 1922, moved on with considerable force.

The British pig iron output last year, estimated at 7,408,000 gross tons, was more than 50 per cent larger than that in 1922, but fell short of both the 1920 and 1913 performances. The steel output, including castings, at 8,585,000 tons, was nearly equal to the combined production of both 1921 and 1922 and was the largest in the last 12 years, excepting 1920. As in the case of the American industry, the greatest volume of output last year was in April and May in both pig iron

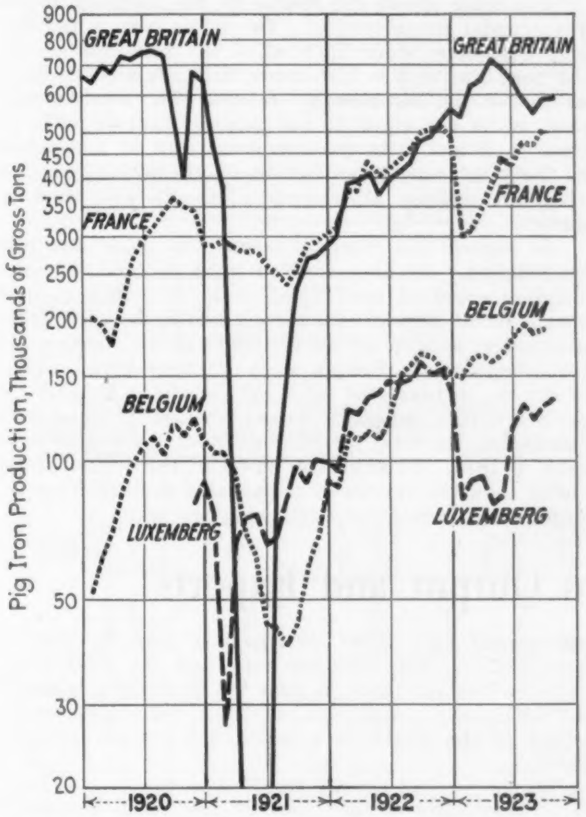
*British Iron and Steel Output and Exports During Peace Years in Gross Tons*

| Great Britain | Pig Iron | Steel | Exports |
|---|---|---|---|
| 1912........ | 8,748,000 | 6,792,000 | 4,807,200 |
| 1913........ | 10,260,000 | 7,688,000 | 4,969,200 |
| 1919........ | 7,404,000 | 7,896,000 | 2,223,200 |
| 1920........ | 8,034,000 | 9,067,200 | 3,250,800 |
| 1921........ | 2,611,200 | 3,625,200 | 1,706,400 |
| 1922........ | 4,899,600 | 5,880,600 | 3,400,800 |
| 1923........ | 7,408,000* | 8,585,000* | 4,407,400* |

*December estimated.

and steel, but at the close of the year, after a moderate recession the output was gradually increasing.

One of the most interesting features of the British industry last year has been the development of the export trade. At 4,407,400 tons the exports have exceeded anything since the war and have almost overtaken the




Pig Iron Output of Four European Countries in the Last Four Years. The recovery in 1923 from the depression in 1921 is emphasized, as is also the effect of the Ruhr occupation early last year

record made in the two years previous to the war. With high cost of production the record is splendid.

## The Industry in Germany

Statistics regarding the German steel industry are unobtainable and the data used in this discussion are largely speculative, particularly as regards pig iron and steel output. From private sources in Germany an estimate has been possible, placing the pig iron output last year at about 4,750,000 tons and the steel output at 5,500,000 tons. As shown by the table these estimates,

*German Iron and Steel Output and Exports During Peace Years in Gross Tons*

| Germany | Pig Iron | Steel | Exports |
|---|---|---|---|
| 1912........ | 15,350,400* | 16,075,200* | 5,812,800 |
| 1913........ | 16,476,000* | 17,340,000* | 6,202,800 |
| 1919........ | 5,654,000 | 6,732,000 | No Data |
| 1920........ | 5,568,000 | 6,624,000 | 1,723,200 |
| 1921........ | 6,096,000 | 8,700,000 | 2,445,600† |
| 1922........ | 6,200,000 | 8,750,000 | 1,827,600 |
| 1923........ | 4,750,000 | 5,500,000 | 1,366,400 |

*Excludes Luxemburg. Last five years partly estimated. 1923 data purely speculation. †Based on 8 months.

which may be high, reflect the low depths to which the German industry has fallen, not only since the pre-war days, but even since 1921 and 1922.

In exports, meager official data have been issued which indicate that the year will show a total of about 1,366,400. These figures, however, are incomplete because of the Ruhr situation and may have to be revised when readjusted data are available. The outstanding feature of the German industry in 1923 has been, of course, the occupation by the French of one of the most prolific parts of Germany in steel and iron production, resulting more or less in a demoralization of the entire industry.

## The Industry in France

It was to be expected that in proportion as reconstruction in France proceeded, the production of iron and steel would increase as a reflection of that development. Last year both the pig iron and steel output justified this expectation. While these in each case exceed the pre-war output, and on the surface indicate

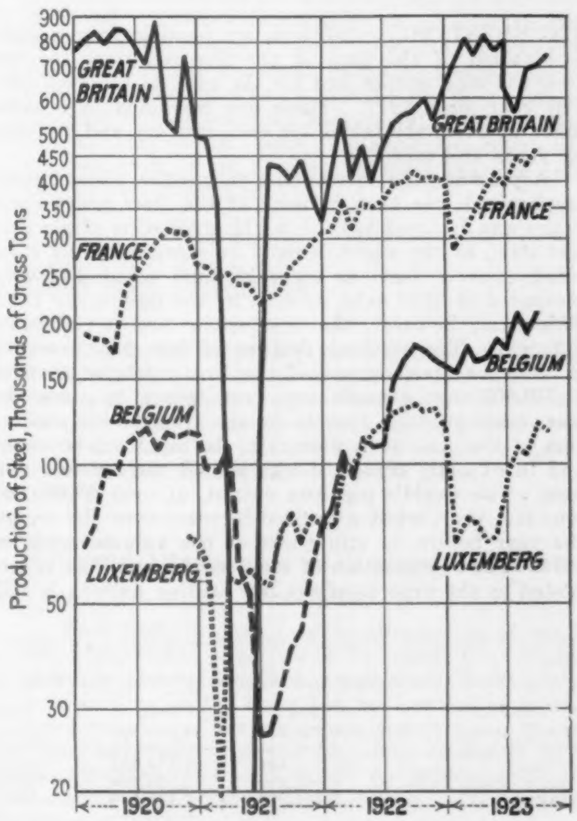
*French Iron and Steel Output and Exports During Peace Years in Gross Tons*

| France | Pig Iron | Steel | Exports |
|---|---|---|---|
| 1912........ | 4,860,000 | 4,356,000 | 498,000 |
| 1913........ | 5,124,000 | 4,620,000 | 578,400 |
| 1919........ | 2,376,000 | 2,148,000 | 232,800 |
| 1920........ | 3,380,400 | 3,002,400 | 895,200 |
| 1921........ | 3,363,600 | 3,054,000 | 1,462,400 |
| 1922........ | 5,146,800 | 4,464,000 | 1,936,800 |
| 1923........ | 5,151,700* | 4,822,000* | 2,114,900* |

*Partly estimated.

a striking development, the 1923 records are not so significant when the great increase in capacity of the country is considered, because of the acquisition of former German steel producing sections.

The pig iron output last year, which will be close to 5,151,700 tons, exceeds the pre-war output in 1913 and is over twice the country's record in 1919. The steel output last year at 4,822,000 tons also exceeds the 1913




Steel Output, Including Castings, of Four European Countries from 1920 to 1923. Effects of the depression of 1921 and the Ruhr occupation are brought out

record and is much over twice the quantity made in 1919. As shown by the table, the recovery of the French industry from the low records following the war is one that the country may well be proud of, although in reference to increased capacity the results are considerably below the possibilities. It should be added that at the end of the year both the pig iron and steel production had attained a volume in each month exceeding any month since the Armistice, and also larger than the average output before the war, indicating still better records for 1924.

France has often been designated as a country which could not handle a large export trade. As far

back as 1913, when the country's steel output was nearly equal to that of last year, the exports were a very small proportion. Possibly the most interesting feature of the developments of 1923 has been the expansion in French exports. At an estimated total of 2,114,900 tons they exceed by a liberal margin, not only the record in the two years previous, but are nearly four times the volume in 1913. Still more startling is the fact that they also are larger by nearly 200,000 tons than the exports of the entire American industry in the same year.

### The Industry in Belgium

The outstanding feature of the world's iron and steel output last year, as represented by the five countries under review, is that of Belgium. While the output of both pig iron and steel for the year will not equal, but will closely approach, that previous to the war, by the end of 1923 the monthly rate of both the pig iron and the steel production had reached a volume larger than the monthly rates before the war. In view of the fact that the Belgian steel industry suffered more from the devastation of the war than that of any other country, this record is an enviable one.

*Belgian Iron and Steel Output and Exports During Peace Years in Gross Tons*

| Belgium | Pig Iron | Steel | Exports |
|---|---|---|---|
| 1912........ | 2,304,000 | 2,472,000 | 1,494,000 |
| 1913........ | 2,445,600 | 2,427,600 | 1,545,600 |
| 1919........ | 247,200 | 328,800 | 174,000 |
| 1920........ | 1,112,400 | 1,215,600 | 891,600 |
| 1921........ | 861,600 | 780,000 | 910,800 |
| 1922........ | 1,578,000 | 1,538,400 | 2,110,800 |
| 1923........ | 2,121,200* | 2,210,600* | 2,360,900* |

*Partly estimated.

The table shows the course of the industry in the years under consideration. There has been a remarkable expansion since 1919 when the total output for the year was only a little more than the amount made in each of the last months of 1923. The total in each case, while not equal to the volume made in 1913, is close to it and with the increased rate of production as the year came to an end there are indications that 1924 will eclipse all records of the Belgian steel industry.

In exports also a signal record was made last year by Belgium. At an estimated total of 2,360,900 tons, Belgium exported more steel than any other country except Great Britain. In these exports, however, there also enter, because of an economic union between the two countries, the foreign sales of Luxemburg. These, of course, increase the total volume of the Belgian exports and it is impossible to say whether, if these were subtracted, the total for Belgium would be less or more than in 1913. In any case, however, the course of the entire industry reveals a remarkable revival from the prostration immediately following the war.

## The World as a Whole in Output and Exports

INTERESTING comparisons are possible from a combination of the data of the five countries for pig iron and steel output and for the exports for each normal year since 1912. These are combined in a table made up from the tables for each country and grouped by years and totals.

A year ago the outstanding fact which these figures emphasized was that in none of the four years since peace was declared had the world production of pig iron and steel, or the world demand as represented by combined exports, been as large as that before the war, measured by 1913 data, or even by the figures for 1912. This year, however, the conclusions are considerably different. The striking feature of last year's record is that the steel output of the five countries at over 65,750,000 tons exceeds any year before or since the war, made possible largely by the tremendous production of the American industry. In pig iron, however, and in exports, 1923 still lags behind the pre-war volume. The world's pig iron output, at over 59,680,000 tons last year, while a decided increase over the record the year before, is still short of the volume made in 1913. The consumption of steel by the world as represented by the exports of the five leading nations is still sub-normal. At 12,244,600 tons last year the increase over 1922 is only 1,000,000 tons and the discrepancy between last year and the year before the war is nearly 4,000,000 tons—conclusive evidence that the buying power of the world as a whole has not yet asserted itself.

In pig iron, of course, the United States still leads with practically 67 per cent of the total production last year or a much larger percentage than in 1922. In 1919, 1920 and 1921 the proportions were 66 per cent, 67 per cent and 55 per cent respectively. In 1913 the American production was only about 47.50 per cent of the total. In 1920 the world production of pig iron was 84 per cent of that in 1913; in 1922 the proportion was 69 per cent, but in 1923 it was 91 per cent.

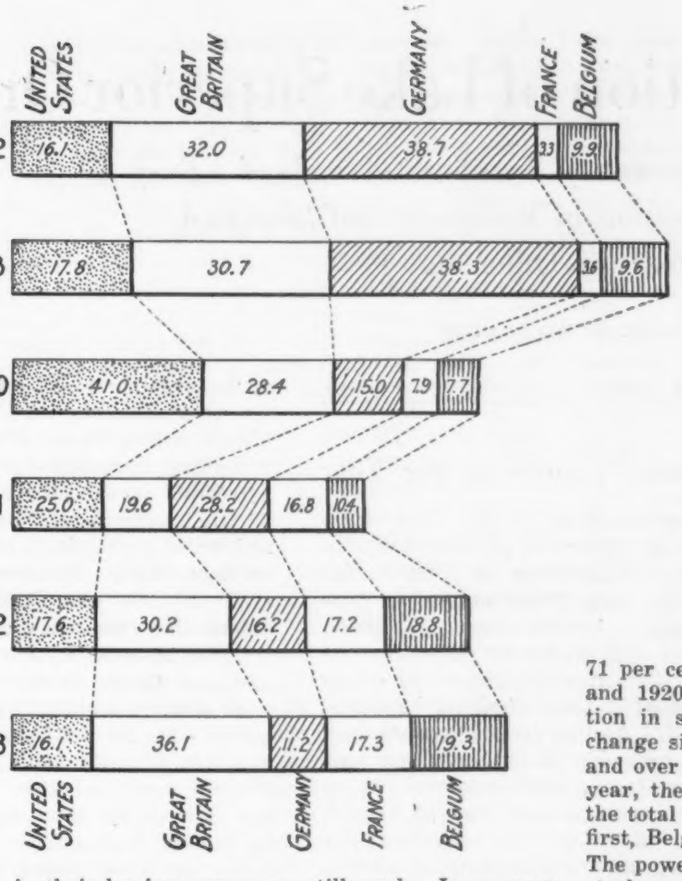
In steel, the world output for the first time last year exceeds that of the years before the war. In this case also the United States is the leader, being credited with nearly 68 per cent of the world's total as compared with 63.50 per cent in 1922 and 49.5 per cent in 1913. Only in 1921 did the American steel output fall below that of 1913.

In exports the so-called "world hunger" for steel has not yet been satisfied. The large consuming coun-

*World Production and Exports of Steel and Iron as Represented by the Five Leading Nations, in Gross Tons*

| *Pig Iron:* | 1912 | 1913 | 1919 | 1920 | 1921 | 1922 | 1923* |
|---|---|---|---|---|---|---|---|
| United States ....... | 29,727,000 | 30,966,000 | 31,015,000 | 36,926,200 | 16,688,000 | 27,220,000 | 40,250,000 |
| Great Britain ....... | 8,748,000 | 10,260,000 | 7,404,000 | 8,034,000 | 2,611,200 | 4,899,600 | 7,408,000 |
| Germany ........... | 15,350,400 | 16,476,000 | 5,654,000 | 5,568,000 | 6,096,000 | 6,200,000 | 4,750,000 |
| France ............. | 4,860,000 | 5,124,000 | 2,376,000 | 3,380,400 | 3,363,600 | 5,146,800 | 5,151,700 |
| Belgium ............ | 2,304,000 | 2,445,000 | 247,200 | 1,112,400 | 861,600 | 1,578,000 | 2,121,200 |
| Totals ......... | 60,989,400 | 65,271,000 | 46,676,200 | 55,021,000 | 29,620,400 | 45,044,400 | 59,680,900 |
| *Steel:* | 1912 | 1913 | 1919 | 1920 | 1921 | 1922 | 1923* |
| United States ....... | 31,251,000 | 31,300,000 | 34,671,000 | 42,133,000 | 19,784,000 | 35,603,000 | 44,650,000 |
| Great Britain ....... | 6,792,000 | 7,688,000 | 7,896,000 | 9,067,200 | 3,625,200 | 5,880,600 | 8,585,000 |
| Germany ........... | 16,075,200 | 17,340,000 | 6,732,000 | 6,624,000 | 8,700,000 | 8,750,000 | 5,500,000 |
| France ............. | 4,356,000 | 4,620,000 | 2,148,000 | 3,002,400 | 3,054,000 | 4.464,000 | 4,822,000 |
| Belgium ............ | 2,472,000 | 2,427,600 | 328,800 | 1,215,600 | 780,000 | 1,538,400 | 2,210,600 |
| Totals .......... | 60,946,200 | 63,375,600 | 51,775,800 | 62,042,200 | 35,943,200 | 56,236,000 | 65,767,600 |
| *Exports:* | 1912 | 1913 | 1919 | 1920 | 1921 | 1922 | 1923* |
| United States ....... | 2,418,000 | 2,892,000 | 4,399,000 | 4,706,400 | 2,172,000 | 1,986,300 | 1,995,000 |
| Great Britain ....... | 4,807,200 | 4,969,200 | 2,223,200 | 3,250,800 | 1,706,400 | 3,400,800 | 4,407,400 |
| Germany ........... | 5,812,800 | 6,202,800 | No Data | 1,723,200 | 2,445,600 | 1,827,600 | 1,366,400 |
| France ............. | 498,000 | 578,400 | 232,800 | 895,200 | 1,462,400 | 1,936,800 | 2,114,900 |
| Belgium ............ | 1,494,000 | 1,545,600 | 174,000 | 891,600 | 910,800 | 2,110,800 | 2,360,900 |
| Totals ......... | 15,030,000 | 16,188,000 | ......... | 11,467,200 | 8,697,200 | 11,262,300 | 12,244,600 |

*Estimated.




Relative Exports of Iron and Steel from the United States, Great Britain, Germany, France and Belgium—These Five Being the Chief Sources of Supply for the Rest of the World. Data for two pre-war years and for four post-war years are compared. The diagram shows that the United States has lost, since 1920, more than half its great share of that year and continued to decline in 1923; Great Britain, France and Belgium have been the chief beneficiaries

tries in their buying power are still weak. In no year since the war have the total exports approached those of 1913, but the record last year shows some progress. At 12,244,600 tons the 1923 record was above three-fourths of the 1913 movement, as compared with about 71 per cent in 1920 and 70 per cent in 1922. In 1919 and 1920 the United States held a commanding position in steel exports but this has suffered a radical change since then. Producing 68 per cent of the steel and over 60 per cent of the pig iron of the world last year, the United States exported only 16 per cent of the total and fell to fourth position with Great Britain first, Belgium second, France third and Germany fifth. The power of the American people to consume iron and steel was demonstrated in 1923 by the fact that, while the steel output exceeded that of 1913 by over 13,000,000 tons, the exports were only about two-thirds of the pre-war year, or the smallest in many years in proportion to the production.

# Output of All Producing Nations

THE quantity of pig iron and steel produced by countries other than the five used in the analysis is not large. It was much greater in 1912 and 1913 than in any year since the war. The British statistics referred to also give fairly complete data for most of the other 12 producing nations up to 1921 inclusive. It is possible to make, however, an approximate estimate for 1923. The results of the known and estimated data may be expressed as follows in thousands of gross tons:

| | 1913 | 1920 | 1921 | 1923* |
|---|---|---|---|---|
| *Pig Iron:* | | | | |
| All countries (17) | 77,296 | 59,051 | 33,279 | 64,521 |
| Leading nations (5) | 65,271 | 55,021 | 29,620 | 59,681 |
| Small producers (12) | 12,025 | 4,030 | 3,659 | 4,840 |
| *Steel Ingots and Castings:* | | | | |
| All countries (17) | 74,921 | 66,723 | 37,982 | 71,007 |
| Leading nations (5) | 63,376 | 62,042 | 35,943 | 65,767 |
| Small producers | 11,545 | 4,681 | 2,039 | 5,240 |

*Estimated.

These data bring out several interesting facts. In both pig iron and steel the smaller producing countries Canada, Luxemburg, Sweden, Austria, Hungary, Czecho-Slovakia, Spain, Italy, Russia, Japan, India and Australia—have in no year since the war produced anywhere near as much as in 1913. Because of this even the world's total of both iron and steel in 1923 had not reached the figures of 1913. This is especially true in pig iron where the discrepancy is nearly 12,500,000 tons, the 12 countries producing last year an estimated tonnage of only 4,840,000 tons compared with 12,025,000 tons 10 years before. The difference in steel is much less: For the world's total it is 4,164,000 tons; for the 12 countries it is 5,240,000 tons compared with 11,545,000 tons in 1913.

Despite the heavy steel production last year of the five leading countries, the world's total is still less than in the year before the war—convincing testimony of the unsettled conditions still prevailing in even the smaller nations. Worthy of note also is the fact that in 1913 more pig iron than steel was made in the world and that now steel predominates and has in each year since the war. Less and less pig iron is needed, a condition which may prevail for many years more.

## Reduced Operations in Unoccupied Parts of Germany

WASHINGTON, Jan. 1.—The elimination of much of the competition experienced by machinery manufacturers in unoccupied Germany as a result of conditions now existing in the Ruhr has not sufficed to stimulate these industries, according to a report received by the Department of Commerce from Vice-Consul C. T. Steger, Dresden, Germany, based on information of the Association of Saxon Manufacturers. This fact, it is stated, is evidenced in the numerous shutdowns among the small shops and partial shutdowns and reductions in working hours in the larger shops.

Foreign business in paper and paper-box machinery, the vice-consul reports, has declined continually in recent weeks. The increasing production costs and consequently increased prices are also making themselves felt in the domestic business. Even those firms for which strong competition was removed by cutting off of the competing manufacturers in the Rhine country are said to be experiencing a decrease in orders.

Machines for the manufacture of precision instruments have been practically unsalable in foreign countries, the report states, wages for the skilled workmen in this industry having risen much faster than the foreign exchange rates. Orders are booked occasionally, it is pointed out, but only at times of sudden mark depreciation.

# Intensive Production of Lake Superior Ores

## Important Achievements and Significant Trends of a Busy Year—No Exploration in Minnesota and Increased Activity in Other States

BY D. E. WOODBRIDGE*

THE rapid recovery of the ore trade is interesting; in 1922 shipments were forty-three million tons, which was practically double those of the year before. But in 1923 total lake and rail shipments amounted to about 61,000,000 tons, of which 59,037,000 tons was by water and the rest all rail to furnaces. In spite of this, the end of the season saw above a million tons less ore on docks than had been there a year before. The future is faced with a tempered optimism; operators feel that demand in 1924 will be good and that ore prices will remain about as they were the past season, or on the basis of $5.55 for Mesabi non-Bessemer ranging to $6.45 for old range Bessemer, lower lake docks. The premium for phosphorus below non-Bessemer standard is, however, becoming more theoretical than real. The actual cost of getting ores from Minnesota to the lower lakes may be put at $1.84 per ton, and there is now no great probability of any material change in this figure next year. Some prophets predict lower ore prices in 1924, but at the mine end of the vista one fails to see how they can be justified. In but three years, and those of the height of war's demand, have shipments exceeded those of 1923. This is the more remarkable, as exports of steel were comparatively small last season, and the great business was essentially domestic. Mining companies, not only on Lake Superior but elsewhere, evidently are confident of a continuation of large demand, and they are preparing for it. Not only is the normal number of men employed in development of various sorts at surface and underground mines, but there has not been a time in many years when machinery and equipment projects out for figures have been as general as they are today.

### Important Features of the Year

*The year in iron ore has been characterized by intensive production; remarkable coordination in transportation all the way from mines to furnaces, also cooperation between mines and railroads; an extension of projects for beneficiation of lean ores; almost a total lack of exploration for ore bodies in Minnesota and renewed activity elsewhere; an emphasis in the trend toward closer grading on manganese content, which had been more or less marked for some time; severe competition of imported ores along the Atlantic Coast, which is usually served to some extent from Lake Superior; important all-rail shipments to furnaces in the Central West and South; freedom from labor troubles, and a good supply of men in all branches of the ore and transportation industry; a closer control of ores by larger organizations; the grinding out in Minnesota of smaller and independent holders of ore by the inexorable pressure of applied socialism, and the definite declaration of a policy for the bonusing of beneficiated ores produced in the province of Ontario.*

#### Fears Not Realized

At the beginning of the season, there was general fear of a shortage of men, which would mean unrest, and strikes probably. Neither mines, ships nor railways have been troubled. The situation has worked out well; men have been in good, but not overabundant, supply all along the line; a few incipient strikes easily were handled without friction or loss. The I. W. W. ideas are so thoroughly abominated by business interests of the mining centers that any troubles fostered by its organizers are lost before they start, and the United Mine Workers and the Western Federation have never secured a foothold in the lake region.

Ore movement started late and ended early; it meant an average daily business of about 400,000 tons; the two outstanding railroads were the Duluth, Missabe & Northern and the Great Northern, to their piers at Duluth-Superior harbor. The former frequently exceeded a daily average of 200,000 tons and the latter moved more ore than ever in its history, with single trainloads, at times, upwards of 7000 gross tons. It is interesting that traffic on the Missabe road, which moves in an almost continuous stream, is run without schedule, all trains being wild. I fail to recall an accident of importance to any ore train on that line during the year.

Several plants for crushing and sorting Mesabi ores have been installed, some additional wash plants are in contemplation, and the proportion of treated ores delivered is increasing. There are now 27 such plants in Minnesota, most of which operated during the year. These include everything from straight washing to remove silica and paint rock to magnetic concentration and operations for crushing and screening hard ores. The method of the Mesabi Iron Co. has undergone some changes, and one step of the company's process is concentration on shaking wet tables working in closed circuit with fine grinding, excessively fine tailings going to magnetic separators.

#### Not Exploring in Minnesota

Mining operators are badly soured on Minnesota, and are not searching for new ore deposits in the State; they are mining as rapidly as may be, and production from the State shows an increased proportion over previous years. This is made necessary by excessive taxation, which compels as large a production as possible, in order to reduce costs. Exploration is a thing of the past in the State, though in Michigan it is active. On the Eastern Gogebic, the Jones & Laughlin Steel Corporation has developed by drilling two deposits east of Sunday Lake, and both the Hanna Ore Co. and the Thomas Furnace Co. have found new ores thereabouts. Ontario is beginning to bid actively for a share of the activity in exploration that must come in time, with a governmental program that contem-

*Mining engineer, Duluth, Minn.

plates a bounty on ores mined in the province. Northwest of Lake Superior are tremendous quantities of lean magnetites that are available for beneficiation, and these surely will be attacked. With the advantage of a short haul to the lake and a bounty they should become profitable ventures. The province is definitely committed to this policy, having made its declaration of principles at a public meeting recently. The policy is for the bonusing of beneficiated ores produced in the province to the extent of $1 per ton, for a term of 10 or 20 years. It is expected that the province will pay half of the monies accruing under this scheme, the Dominion the other half. As yet no official pronouncement has been made by the Dominion.

### Results of Socialistic Teaching

Minnesota is experiencing the actual result of the doctrines of Carl Marx and the Bolsheviki: that by reason of confiscatory taxation natural resources may be nationalized and private ownership eliminated. This may sound alarming, but it is a fact that has come to pass, and is in direct confirmation of the predictions made for years before the State legislature by those who pleaded for a reasonable attitude toward the mineral industry. Case after case might be cited of properties on which, for long periods, royalties and taxes had been paid that now have been abandoned and have reverted to original owners, sometimes to private fee owners, sometimes to the Commonwealth. Private fee holders, or original State lessees, upon endeavoring to make new operating contracts, discover that under present conditions there is no value in their holdings, and they must either carry them indefinitely at high taxation costs or they must drop them. The large operator, who can absorb the tax in general costs or, better still, can add it to the price of steel and who can exhaust individual mines quickly is in a less precarious position, and the general effect is that the bigger the company the less severely it is hit, thus giving the lie to those legislators who profess deep solicitude for the small holder. It is really an alarming situation; it puts a quietus on individual initiative, and many tracts that, under ordinary procedure, would be productive of revenue are likely to become an obligation rather than an asset. These remarks apply, of course, to undeveloped mineral lands and not to operating mines.

### Some Operators Leave State

Some of the operators have left the State altogether for the present. Among these is the Republic Iron & Steel, whose Lake Superior activities, which in 1922 were from five mines, will the coming year be confined to its Plumer, Townsite and Cambria, the first named in Wisconsin and the others in Michigan. Plumer is an exploration west of Hurley, under development for some years, but from which not much ore has yet been taken. Townsite is a portion of the old Norrie, dropped some years ago by the Oliver company, and Cambria is an old mine in the Marquette district, operated first in 1875. Republic has given up its Schley mine in Minnesota and has been scramming others of its properties near the town of Virginia.

Cuyuna range shipments for the year were about 2,200,000 tons, lake and rail; most of it came from large pits and it was chiefly manganiferous. Shippers both there and elsewhere are grading more closely on manganese percentage than in the past, some operators down to 2 and 3 per cent. More manganiferous ore is going from the older ranges, because of this grading, than formerly.

### Operations of Ford Motor Co.

The Ford Motor Co. is carrying on a considerable ore exploratory campaign covering its timber lands in northern Michigan, in the vicinity of Republic and elsewhere. It is generally understood that, so far at least, this campaign has been rather unsuccessful in locating ore bodies of size and value. The company produced this year about 200,000 tons from its Imperial mine near Michigamme, an ore assaying about 44 per cent iron, natural. It has been completing its requirements by open market purchases from various interests, these including almost the entire output of Mesabi sinter. Ford plans call for an early and material increase in pig iron production and a very large addition to its present theoretical consumption of about 650,000 tons of ore per year. Its policy is to acquire raw materials in fee, today a difficult matter in the Lake region. By next spring it will have a seasonal carrying capacity, its own ships, for about 1,000,000 tons of ore, indicating large additional production from some source. It has been persistently rumored that it has been negotiating for the capital stock of the Cleveland-Cliffs Iron Co., but no announcement has been made either way. The Cleveland-Cliffs owns mines, railways, shipping piers, vessels, furnaces, and timber lands, is strong and self contained.

Operation of Armstrong Bay mine, Vermillion range, has been abandoned after the expenditure there and elsewhere on that range of a very large sum. This work was by automobile interests. Loon Lake explorations, east from Port Arthur, have been abandoned by the Hanna Ore Co. Bethlehem Steel has ceased all work in the district east of Lake Nipigon. The Oliver company is opening several new mines on the western Mesabi and is conducting extensive developments on the Gogebic, at Norrie and elsewhere. Pickands, Mather & Co. are employing for the winter in development about 80 per cent of their summer mining force of 4000 men. Developments on the Gogebic are heavy and by four or five large operators. Winter stripping is under way on the Cuyuna. The Hanna ore interests are making important preparations for the coming year.

Lake Superior shipments by the larger interests run in about the usual proportions, except that Pickands, Mather & Co., through association with Bethlehem and others, have reached a point where nearly a third of all lake ore, independent of the Steel Corporation, is under their management. Their season's forwardings amounted to nearly 9,000,000 tons. The Steel Corporation shipped about 29,000,000 tons.

### In Other States

Efforts are being made to revive the iron ore industry in Missouri, and shipments already are being made from a new concentrating works at Iron Mountain, 85 miles south of St. Louis. Examinations are under way at other properties in that vicinity and the secondary limonite lands in Wayne and other Missouri counties are receiving attention. In this latter district are many banks of limonite, similar to the deposits in western Georgia, around Tannehill, Ala., and in west Tennessee, where brown ores are washed for the local markets. All told, there is probably an enormous quantity of such ores in southeast Missouri, though tonnage is hard to estimate, and the ores occur in hundreds of banks. The real opportunity in the State perhaps lies more definitely in the specular hematites in porphyry, as near Iron Mountin and Pilot Knob, from which properties more than 5,000,000 tons of very high grade ore has been shipped. Most of the ores consumed near St. Louis now are brought from the Lake Superior region under high freight costs, and if that district can discover an adjacent reserve of proper quality and permanence, its future as a steel making center is worthy of consideration.

Ores of southwest Utah will soon enter the market, for the works now under construction in that State. They exist in quantity and are of good quality. A

study is being made of the high grade ores of the Hanover, N. M., region, in the hope that they can be sent in larger quantity to Pueblo, or perhaps to Chicago or St. Louis.

# Satisfactory Year for Lake Superior Iron Ore

## Excellent Record of Railroad Service a Feature of the Year—Limited Demand from Eastern Furnaces—No Labor Troubles

THE year 1923 was generally a very satisfactory one in the Lake Erie Superior iron ore trade. Consumption of lake ore during the year was approximately 62,000,000 tons. For the 12 months from Dec. 1, 1922, to Dec. 1, 1923, the amount actually consumed as shown by blast furnace reports was 62,661,460 gross tons. This compares with a maximum during any 12 months of 64,493,862 tons from April 1, 1918, to April 1, 1919. That 1923 was not close to a record-breaking year in the point of consumption was due to the very limited demand for lake ore from Eastern furnaces, brought about by the low prices on foreign ore and the almost prohibitive freight rates on lake ore for shipment to Eastern consumers.

The amount of ore on hand at furnaces and docks Jan. 1, 1924, was approximately 1,000,000 tons less than at the beginning of 1923. On Dec. 1 the amount was 42,836,466 tons as compared with 44,004,201 tons on the same day in 1922. Previous records of lake ore consumption in any one month were broken during four successive months in 1923 starting with April. The peak was reached in May with the total consumption of 6,118,540 tons. Previous to 1923 the largest amount consumed in any one month was 5,499,928 tons in October, 1918.

An outstanding factor of the iron ore movement during 1923 was the excellent transportation facilities provided by the railroad for handling ore from Lake Erie docks to interior furnaces. During many of the previous seasons, car shortages retarded the movement of ore boats, delays of vessels at Lake Erie ports waiting for cars to take ore cargoes being frequent. Last year, with more cars and with some of the larger railroad equipment diverted to ore handling exclusively, there was never any complaint about the services rendered by the railroads.

The total ore movement during the season was 59,036,704 gross tons, being exceeded in only three previous years—war-time years when water shipments passed the 60,000,000 mark three years in succession and reached a maximum in 1916 with a movement of 64,734,188 tons. All rail shipments in 1923 are estimated at 1,800,000, making a total movement for the season close to 61,000,000 tons. Last year's water shipments showed a gain of 38.52 per cent over 1922, when the movement by water was 42,613,229 tons. Shipments during 1923 were well up to predictions made at the beginning of the year. At that time estimates of the season's shipments ranged from 56,000,000 to 60,000,000 tons.

Ore prices were established March 24 at an advance of 50c. a ton over the previous year or to $5.55 per ton for Mesabi non-Bessemer ore. This advance brought prices back to those prevailing in 1921. A heavy buying movement followed and sales were well over by the middle of April. Previously there had been some sales of dock ore due to the heavy blast furnace operations in the early months of the year. Vessel rates were established in the spring at 80c. a ton from the head of the lakes. This was an advance of 10c. a ton, so that the net advance to the mining companies on ore was 40c. a ton.

Rail rates agitation as to ore was not of the outstanding importance during 1923 that it had been during some of the preceding years. The only development in the rail rate situation was a reduction by the Interstate Commerce Commission of from 4c. to 9c. a ton in the rates on ore from the Old Range mines of Michigan and Wisconsin to upper lake ports. These reductions that became effective May 15 were disappointing to the leading independent steel and mining companies that had pushed a suit for lower rates and had hoped for greater reductions than were finally allowed.

The labor situation was fairly satisfactory in the ore mining districts during the year. The Oliver Mining Co., operating the Steel Corporation mines, made a 10 per cent wage advance May 1, and independent mining companies followed with similar advances. Early in the season mine labor was scarce and some of the mines went on a single shift, but this situation was relieved during the summer.

# Secretary Hoover Says Outlook Is Encouraging

WASHINGTON, Jan. 1.—Summarizing world economic prospects for 1924, Secretary of Commerce Herbert Hoover, in a statement made public today, declares that the situation continues under the European cloud of the reparations dispute, etc., while the United States has exhibited extraordinary strength and progress. Europe, he points out, is faced with unbalanced budgets, unstable currencies, and the political uncertainties of armies in the old allied states greater than prewar. Yet, he states, the realization of the necessity for constructive solution of reparations, constructive aid to Austria and Hungary, and the projects for budget reorganization in other countries, "all give hope that we have at last taken a turning." The basis of world business activity in the United States, the Secretary says, lies in balanced budgets, stable currency, high production accompanied by proportionate consumption and savings, with an absence of speculation, extravagance and inflation.

"We have even more to hope for from decreasing taxes," the Secretary said, "and the odds are favorable to 1924."

The statement of the Secretary came upon the heels of a review by the Federal Reserve Board of banking and business developments during 1923. The board declared that in the business and banking developments of 1923 the outstanding fact has been the high level of industrial and agricultural output and the demand for bank credit to finance a volume of production and trade never previously equaled. The review of the board is comprehensively presented and deals with all of the financial aspects of banking, industry, and agriculture.

Commenting on the course of business, the board points out that production reached its peak for 1923 in May and after that time the growth in the demand for credit for commercial purposes slackened. The recession in industrial activity during the summer months, however, it was pointed out, was not accompanied by a decline in the distribution of merchandise and in the autumn the demand for additional credit, largely from agriculture, resulted in a further increase in commercial loans at member banks in leading cities.

# Iron and Steel Metallurgy in 1923

## What Literature Reveals as to Developments in Fuels and Furnaces, Iron and Steel, Alloys and Castings—Value of Research

BY C. E. MAC QUIGG*

WHY the annual review? This may be answered by saying that one wishes to sit down and, in the matter of a short space of time, find out what some one else has thought to be the outstanding features of the past year's progress.

This at once puts the reviewer on the defensive; the reader may, like as not, fail to agree in many respects with the viewpoint of the writer. What may be of the greatest interest to the exporter of that peculiar type of fence wire used for screening silver fox farms is likely to be of the mildest interest to the man seeking to develop a better piston ring! Therefore the reviewer of any subject for a vast and unknown group of discriminating readers must always approach his subject with misgivings.

But, after all, is it not the chief reason for reading a review, that we may see some item, possibly already familiar, which occurring in a particular setting, will set us to constructive thinking on our own problems? Moreover, the ideal review should contain an element of prophecy pointing to future trends as indicated by the chronicling of past achievements. This each reader can best do for himself.

### Fuel and the Blast Furnace

*The Bergius Process:* Belgian commission of fuel experts has recently[1] examined and reported on the Bergius process as carried out at Mülheim-Rheinan, Germany. The scarcity of industrial alcohol and oil in Belgium and Germany has given this subject considerable interest as a means of turning some of the ample coal supply into liquid fuel. The process is of such interest, in view of its bearing on the internal combustion engine, that the inventor is said to have the backing of British, Dutch and German financial circles. The methods have been worked out by a German, one Doctor Bergius, and have been found to apply to such widely varying materials as petroleum residues, tars, coal, coal dust, etc. If liquid, the materials are treated directly; if solid, they are first ground, then mixed with a residual oil to make a paste which is then subjected to elevated temperature and hydrogen under pressure. At the German plant the hydrogen is made by the same process which supplied the gas used by the German Zeppelins during the War. This is made by producer gas, water gas and low steam in a checker stove filled with magnetic oxide of iron. The product is a liquid which can be fractionated into benzol and Diesel engine fuel. Gas of high calorific value is also produced. It is said that the commercial outlook is so promising for exploitation in some European industrial sections that the rights have already been secured by Dutch capitalists for outside exploitation.

*Blast Furnace Coke:* The combustibility of blast furnace coke has been subjected to extended technical discussion in several places[2] recently. The papers have gone into the various methods of determining the combustibility of coke and such other fundamentals as coking times, shatter tests, equilibrium conditions between the carbon and oxygen and other gases for various temperatures, specific gravity, size of coke and its composition. Much of the past important work has been critically examined and it is concluded that the most important factor affecting the combustion of coke is its size. It is hoped to confirm the data of the more or less empirical discussion by further tests on a small scale, by operation at the U. S. Bureau of Mines Experimental Station at Minneapolis. The above mentioned station has been equipped with a blast furnace which embodies radical departures from the accepted design and has even been said to have yielded data which may lead to important modification of blast furnace design in the future.

The furnace stack is only 20 ft. high, but the tests show that a considerable part of the stack is inactive as far as the reducing effect of the furnace gases on the ore is concerned. In other words, there is a gap between the zone at the top, where the reduction actively goes on, and the combustion zone at the bottom. The argument is, that if analogous conditions obtain in commercial stacks, the modern iron blast furnace may be considerably revamped as to shape and size. This would result in marked saving in construction costs and replacements. The hearth diameter of the Bureau's furnace is only 20 in. The furnace is provided with facilities for making temperature and gas determinations at various points. By the use of this small furnace it is expected to be able to undertake studies on the utilization of the fuel in the blast furnace and to accumulate data which may lead to the modification of blast furnace design from the metallurgical standpoint and the smelting of certain ores or mixtures which for one reason or another are not now feasible but which might have decided commercial advantages.

In some fast driving[3] of a blast furnace undergoing tests to determine the best burden factors, it was found possible to use 5 per cent of scrap with little or no extra fuel. It has also been shown that magnetic[4] ore will drive very much faster with smoother running, larger output and fuel economy when sintered. The cost of sintering, which amounted to 80c. per ton of sinter, was more than compensated for by the increased output.

*Hot Blast Stoves:* It is claimed[5] that the so-called P. S. S. process for improving the efficiency of hot blast stoves has received further confirmation in recent investigations. This process briefly involves the use of high pressure blast for the combustion of the gas during the heating period in the hot blast heating cycle. It would appear that not enough data have been given as yet to draw conclusions applicable to American practice.

*Regenerator Coke Plants:* The thermal operation of a modern regenerator coke installation consisting of a battery of 61 ovens has been studied and the heat balances worked out.[6] The ovens investigated were fired by a part of the gas produced. The data obtained resulted in a figure of 87.38 per cent for the efficiency from the *thermal* standpoint. The greatest thermal loss

*Metallurgist with the Union Carbide & Carbon Research Laboratories, Inc., Long Island City, N. Y.

from the process was found to be due to the removal of the hot coke and the investigators suggested that this is important enough to warrant steps looking toward the recovery of at least a part of this energy. Recasting the figures for a "sensible heat balance," it was shown that the output exceeded the input by about 40 per cent, which is, of course, attributable to net exothermic reactions in coking, such as fusion of the coal, evaporation of hydrocarbons and heats of formation of some of the gaseous products. The latest developments in British gas producer products have been summed up in a brief paper appearing early this year. The authors, reviewing the progress of the last 10 years in the by-product type of producer, state that ammonium sulphate recovery has increased from about 70 lb. per ton of coal gasified to about 80 or 90 lb. The paper describes a producer with annular boiler which operates a low pressure steam engine, the exhaust of which is used for blast saturation.

*Piron Process:* What may be one of the outstanding developments of fuel utilization has been the so-called Piron process for the low temperature carbonization of coal. It is generally believed that the low temperature carbonization processes have been under severe commercial handicap because of the lack of economic balance between the increased time required for carbonization and the enhanced value of by-products obtained. This situation has resulted from the low temperature gradient necessary between the furnace gases and the coal being carbonized in the low temperature processes. Inventors have been busy seeking to overcome this natural difficulty. Messrs. Piron and Caracristi have developed a regenerator type of oven utilizing a novel method of heating the coal in a rapid manner. Combustible gases are burned in suitably designed flues under a shallow lead bath which is contained in a rectangular furnace. Passing over this bath of lead and floating upon it is an endless chain with shallow metallic pans. The coal is automatically spread on these pans in a thin layer and passing over the bath of hot lead the coal is rapidly heated because of the high thermal conductivity of the system. The result is that carbonization is effected in a few moments. The semi-coke produced is discharged at the end of the furnace. Provisions are made for retaining the products of combustion. It is said that Mr. Ford has been interested in the process and has been engaged in the erection of a large unit for commercial work. Sketches of the installation indicate a practical type of construction, the only moving part consisting of a conveyor which is constructed of an oxidation-resistant alloy. The product made contains from 10 to 18 per cent volatile matter, depending on the method of operation. While the ash is slightly increased by the coking process, the variation in the nature of the volatile matter may account for a higher net thermal value in the carbonized product. The product is said to burn well under boilers with a yellowish-blue flame and the formation of a fluffy ash.[7]

Much interest, as evidenced by numerous installations, has continued in various types of fuel saving devices.[8] Annealing furnaces are being equipped with recuperators and in one case the use of fuel oil for air furnace melting has resulted in certain advantages of operation and saving in labor. The costs are given as about $38 for the oil against $46.30 for the coal based on a ten ton heat.

*Blast Furnace Slags:* Because of the enormous tonnage produced in this country and the mounting cost of disposal, the subject of the commercial utilization of blast furnace slags has become of considerable economic importance. An authority has recently stated that the total production of furnace slag approximates 20,000,000 tons per year.[9] Assuming a sum of $1 per ton for wasting this material, the immense cost of $20,000,000 results. Granting that to be the exact figure or not, the illustration brings home the commercial importance of the question. Considering the present uses, it is estimated that the break-down for about 7,000,000 tons per year is about as follows:

Of the amount used 45 per cent goes to roads and city building, other than concrete; 25 per cent to railroad ballast; 25 per cent to aggregate in concrete; 1 per cent to roofing, and 4 per cent for miscellaneous applications such as slag brick, concrete blocks, etc. The above is for air cooled slag. It is further estimated that about 1,000,000 tons of slag is granulated yearly for use in the manufacture of Portland cement.

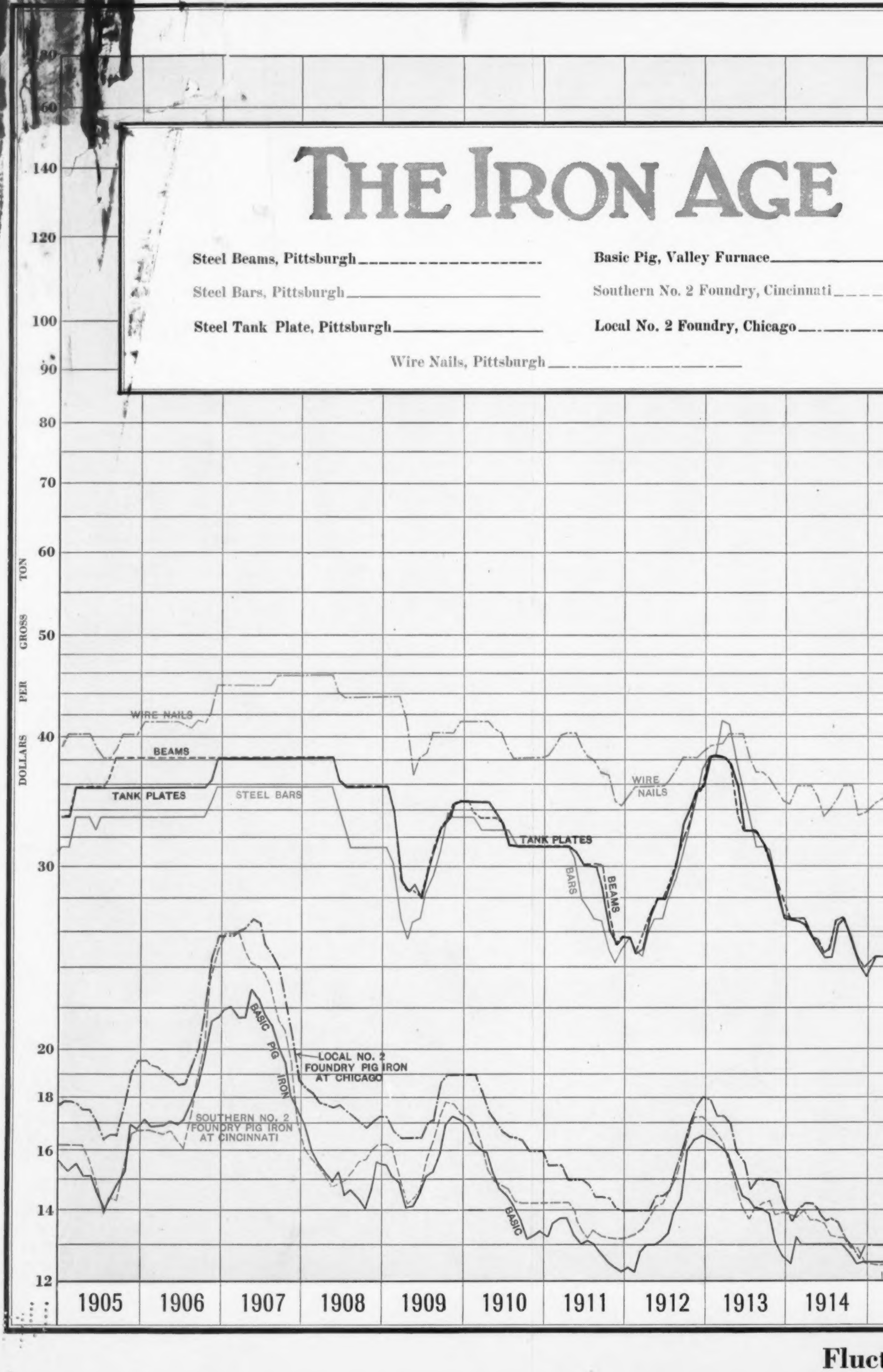
A plant recently started in England for making slag brick[10] is said to be quite successful. The slag used in making slag brick is first granulated. This is done by water but because of the high moisture content of the granulated slag (40 to 50 per cent), the cost of drying was found to be prohibitive, being as much as $1.50 per thousand brick made. The difficulty has been nicely overcome by means of an adjustable trough for regulating the length of time that the slag is in the stream of water before the mixture is fed to an inclined rotating trammel which de-waters it while there is still enough heat in the slag to almost dry the granules. This adjustment is varied depending on the quality and temperature of the molten slag. By this "knack" the moisture content is reduced to about 8 per cent on completely granulated slag, but it is found more desirable to obtain a totally dry slag and stop just short of complete granulation. Reduction is completed in rolls. Measurement of the granulated slag and slaked lime in the proportion of 12 lime to 88 slag is carried out mechanically. The mix is weighed and tempered in a mixing mill. A 200-lb. press forms the blocks which are then wheeled to the hardening tunnels. Hardening is accomplished by steaming at atmospheric pressure for five or six hours. Remarkably uniform brick are supplied with a porosity of between 7 and 8 per cent and a crushing load up to 200 lb. per sq. ft. Immediately after steaming, the brick are ready for shipment but are allowed to weather in the open for about two months. Experiments are being made with coloring the brick. An output of 36,000 brick in 24 hr. is the rating of the plant.

## Open-Hearth Furnaces

Several notable contributions have been made during the year to the discussion of open-hearth technology in German plants. Because of their less extensive circulation here, one or two will be briefly discussed.

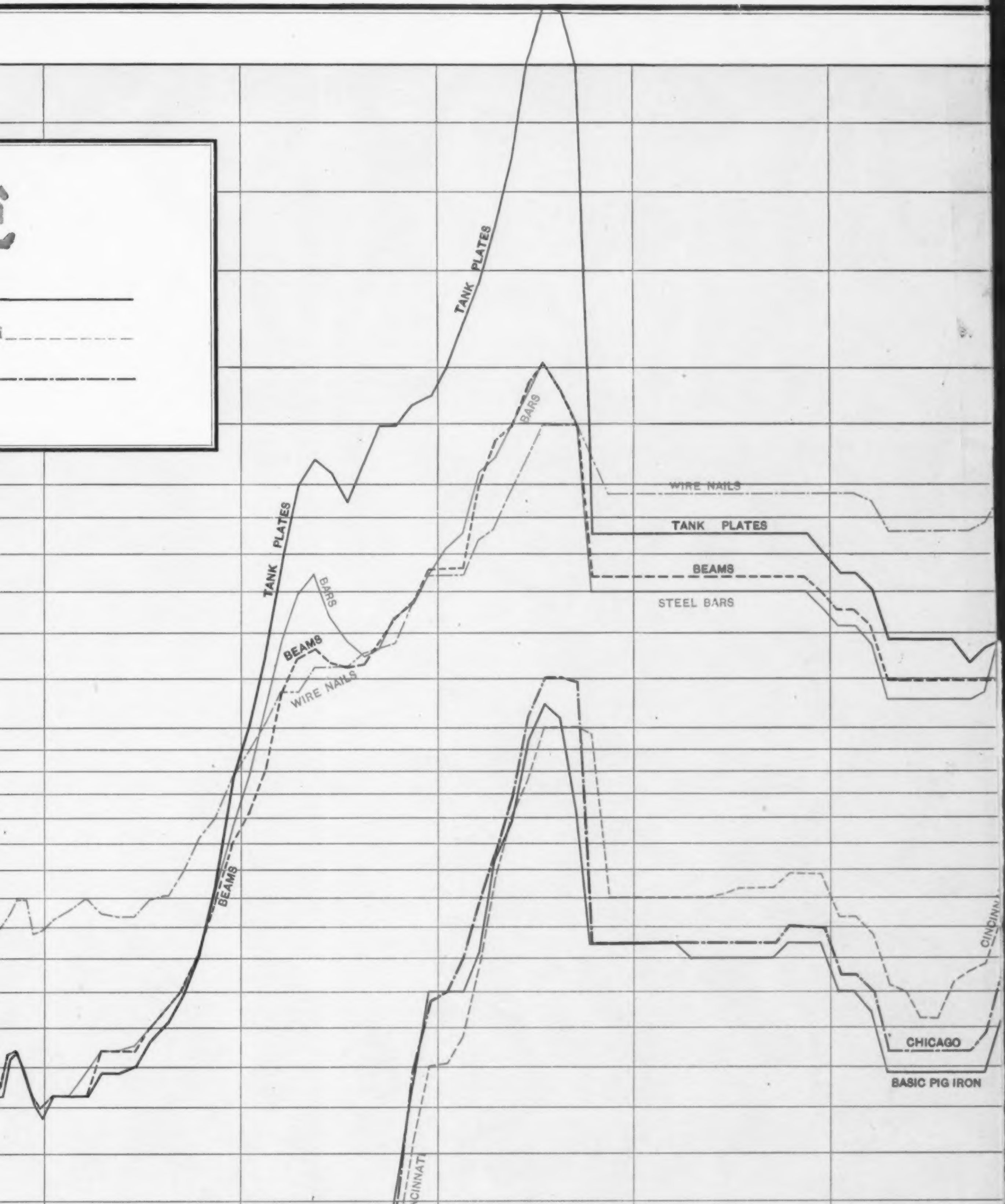
*Firing at High Pressure:* High pressure firing has been carried on with the underlying knowledge that there is no direct relation between the calorific power of a gas and its theoretical composition temperature.[11] Thus methane with 8600 kg. calories has a combustion temperature of 2390 deg. C. when burned with air at 1100 deg. C., while water gas with a calorific power of 2580 kg. calories has a theoretical temperature of combustion, equal to 2420 deg. C. under the same conditions. In order to reach nearer to the theoretical combustion temperature and obtain a higher thermal efficiency, it was proposed to follow the design of the Bunsen burner principle. The tests were made on a 3-ton open-hearth furnace. Pre-heated air was supplied to the specially designed gas inlet. The gas was maintained at 79 in. of water (2.84 lb. per sq. in.), the jet effect sucking in the air for combustion and making a satisfactory mixture. Furnace end design was simplified because the flame could be directed from the aim of the burner alone. Theoretical combustion temper-

(*Continued on page* 91)

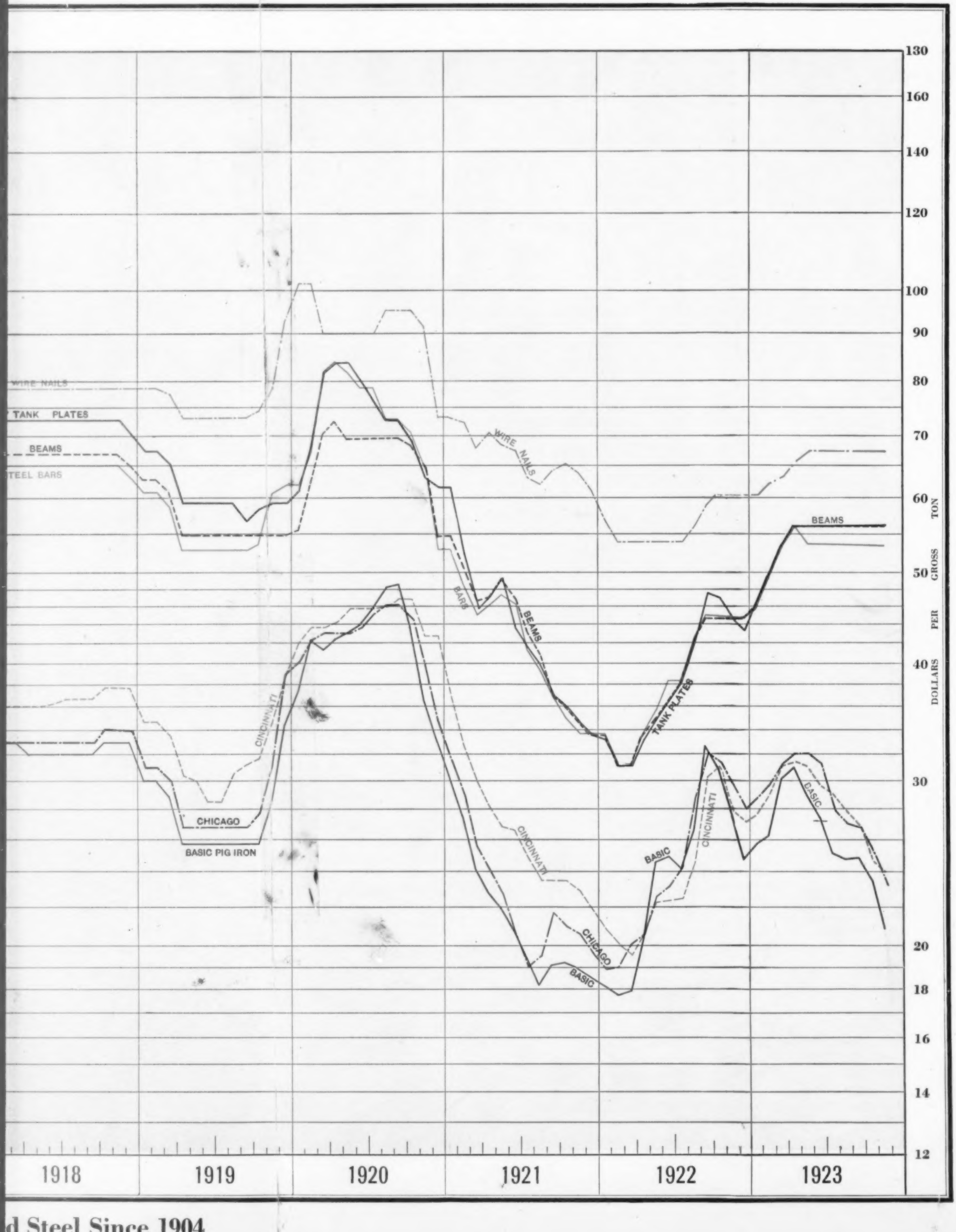


THE IRON AGE
Steel Beams, Pittsburgh
Basic Pig, Valley Furnace
Steel Bars, Pittsburgh
Southern No. 2 Foundry, Cincinnati
Steel Tank Plate, Pittsburgh
Local No. 2 Foundry, Chicago
Wire Nails, Pittsburgh
DOLLARS PER GROSS TON
180
160
140
120
100
90
80
70
60
50
40
30
20
18
16
14
12
WIRE NAILS
BEAMS
TANK PLATES
STEEL BARS
TANK PLATES
BARS
BEAMS
WIRE NAILS
BASIC PIG IRON
LOCAL NO. 2 FOUNDRY PIG IRON AT CHICAGO
SOUTHERN NO. 2 FOUNDRY PIG IRON AT CINCINNATI
BASIC
1905
1906
1907
1908
1909
1910
1911
1912
1913
1914


**Fluct**




**Fluctuations in Prices of Pig Iron and Finished Steel Since 1904**




d Steel Since 1904

# Iron and Steel Prices for Twenty-One Years

## Monthly Averages Computed from the Weekly Market Quotations of THE IRON AGE in the Period of 1903 to 1923

IN this issue of THE IRON AGE are our three colored price charts, in two of which plotted lines indicate the course of prices for pig iron, billets and leading forms of finished iron and steel and non-ferrous metals in the 26 years ended with 1923. The other chart covers 19 years, beginning with 1905. The diagrams are based on monthly averages of prices quoted week by week in our market reports from the leading selling centers. In the tables following are the monthly average prices of more than 50 products, including those on which the charts are based.

*Bessemer Pig Iron at Pittsburgh, Dollars per Gross Ton (2240 lb.)*

| | 1903 | 1904 | 1905 | 1906 | 1907 | 1908 | 1909 | 1910 | 1911 | 1912 | 1913 | 1914 | 1915 | 1916 | 1917 | 1918 | 1919 | 1920 | 1921 | 1922 | 1923 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| January... | $22.15 | $13.91 | $16.85 | $18.35 | $23.15 | $19.00 | $17.34 | $19.90 | $15.90 | $15.05 | $18.15 | $14.96 | $14.59 | $21.58 | $35.95 | $37.25 | $33.60 | $40.00 | $33.96 | $21.56 | $29.27 |
| February... | 21.45 | 13.66 | 16.41 | 18.35 | 22.85 | 17.90 | 16.78 | 19.34 | 15.90 | 14.90 | 18.15 | 15.09 | 14.55 | 21.51 | 35.95 | 37.25 | 33.60 | 42.90 | 31.46 | 21.46 | 29.83 |
| March..... | 21.85 | 14.25 | 16.35 | 18.28 | 22.85 | 17.86 | 16.25 | 18.60 | 15.90 | 15.09 | 18.15 | 15.09 | 14.55 | 21.75 | 37.70 | 37.25 | 32.54 | 43.40 | 28.16 | 21.46 | 32.02 |
| April...... | 21.28 | 14.18 | 16.35 | 18.19 | 23.35 | 17.49 | 15.78 | 18.27 | 15.90 | 15.15 | 17.90 | 14.90 | 14.55 | 21.95 | 42.20 | 36.15 | 29.35 | 43.60 | 26.96 | 22.59 | 32.77 |
| May...... | 20.01 | 13.60 | 16.16 | 18.10 | 24.01 | 16.93 | 15.84 | 17.52 | 15.90 | 15.13 | 17.70 | 14.90 | 14.59 | 21.95 | 45.15 | 36.15 | 29.35 | 44.03 | 26.16 | 26.36 | 31.87 |
| June...... | 19.72 | 12.81 | 16.65 | 18.23 | 24.27 | 16.90 | 16.05 | 16.60 | 15.90 | 15.15 | 17.14 | 14.90 | 14.70 | 21.95 | 54.70 | 36.38 | 29.35 | 44.80 | 24.71 | 26.96 | 30.27 |
| July....... | 18.89 | 12.40 | 14.85 | 18.41 | 23.55 | 16.83 | 16.46 | 16.40 | 15.90 | 15.20 | 16.70 | 14.90 | 14.95 | 21.95 | 57.45 | 36.60 | 29.35 | 47.15 | 22.84 | 26.77 | 28.46 |
| August.... | 18.35 | 12.81 | 15.20 | 19.00 | 22.90 | 16.23 | 17.03 | 16.09 | 15.90 | 15.46 | 16.52 | 14.90 | 15.95 | 21.95 | 54.75 | 36.60 | 29.35 | 49.11 | 21.96 | 29.96 | 28.26 |
| September. | 17.22 | 12.63 | 15.91 | 19.54 | 22.90 | 15.90 | 18.05 | 15.90 | 15.90 | 16.15 | 16.65 | 14.90 | 16.85 | 22.26 | 48.03 | 36.60 | 29.35 | 50.46 | 21.96 | 35.27 | 28.26 |
| October.... | 16.05 | 13.10 | 16.54 | 20.35 | 22.00 | 15.71 | 19.53 | 15.90 | 15.44 | 17.80 | 16.60 | 14.84 | 16.95 | 24.08 | 37.25 | 36.60 | 29.35 | 49.16 | 21.96 | 35.17 | 25.20 |
| November. | 15.18 | 14.85 | 17.85 | 22.85 | 20.65 | 16.59 | 19.90 | 15.82 | 15.00 | 18.02 | 16.02 | 14.59 | 17.51 | 30.15 | 37.25 | 36.60 | 31.26 | 41.10 | 21.96 | 33.52 | 23.25 |
| December.. | 14.40 | 16.65 | 18.35 | 23.75 | 19.34 | 17.40 | 19.90 | 15.90 | 15.03 | 18.15 | 15.77 | 14.70 | 19.65 | 35.68 | 37.25 | 36.60 | 36.65 | 36.96 | 21.96 | 29.90 | 21.64 |
| *Average..* | *18.88* | *13.74* | *16.46* | *19.45* | *22.65* | *17.06* | *17.41* | *17.19* | *15.71* | *15.94* | *17.12* | *14.89* | *15.78* | *23.90* | *43.64* | *36.67* | *31.09* | *44.39* | *25.34* | *27.58* | *28.68* |

*Basic Pig Iron, f.o.b. Mahoning or Shenango Valley Furnace, Dollars per Gross Ton*

| | | | | | | | | | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| January... | ..... | ..... | $15.46 | $17.06 | $21.90 | $16.90 | $15.50 | $16.87 | $13.25 | $12.35 | $16.41 | $12.50 | $12.50 | $17.81 | $30.00 | $33.00 | $30.00 | $37.40 | $30.00 | $18.15 | $25.80 |
| February.. | ..... | ..... | 15.25 | 16.82 | 22.00 | 15.97 | 15.12 | 16.31 | 13.65 | 12.25 | 16.30 | 13.19 | 12.50 | 17.69 | 30.00 | 33.00 | 30.00 | 42.25 | 27.50 | 17.75 | 26.25 |
| March..... | ..... | ..... | 15.55 | 16.85 | 21.50 | 15.62 | 14.94 | 16.00 | 13.75 | 12.81 | 16.11 | 13.00 | 12.50 | 18.20 | 32.25 | 33.00 | 28.94 | 41.50 | 24.20 | 17.94 | 30.13 |
| April...... | ..... | ..... | 15.06 | 16.88 | 21.50 | 15.25 | 14.05 | 15.94 | 13.75 | 13.00 | 15.87 | 13.00 | 12.50 | 18.13 | 38.75 | 32.00 | 25.75 | 42.40 | 22.88 | 20.00 | 31.05 |
| May...... | ..... | ..... | 15.06 | 17.00 | 22.90 | 14.91 | 14.12 | 15.19 | 13.32 | 13.00 | 15.15 | 13.00 | 12.50 | 18.00 | 41.60 | 32.00 | 25.75 | 43.25 | 22.00 | 24.60 | 29.00 |
| June...... | ..... | $11.76 | 14.60 | 16.94 | 22.40 | 15.25 | 14.62 | 14.70 | 13.05 | 13.12 | 14.50 | 13.00 | 12.50 | 18.00 | 48.75 | 33.00 | 25.75 | 44.00 | 20.75 | 25.00 | 27.38 |
| July....... | ..... | 11.20 | 14.00 | 17.12 | 21.75 | 14.51 | 15.05 | 14.50 | 13.12 | 13.40 | 14.37 | 13.00 | 12.74 | 18.00 | 52.50 | 32.00 | 25.75 | 45.85 | 19.38 | 24.25 | 25.10 |
| August.... | ..... | 11.60 | 14.32 | 17.70 | 21.25 | 14.69 | 15.25 | 14.12 | 13.00 | 13.94 | 14.06 | 13.00 | 14.06 | 18.00 | 51.20 | 32.00 | 25.75 | 48.10 | 18.20 | 26.00 | 24.75 |
| September. | ..... | 11.60 | 14.86 | 18.44 | 20.06 | 14.43 | 15.90 | 13.70 | 12.80 | 14.37 | 14.00 | 13.00 | 14.75 | 18.31 | 42.75 | 32.00 | 25.75 | 48.50 | 19.13 | 32.63 | 24.88 |
| October.... | ..... | 12.19 | 15.25 | 19.55 | 19.50 | 14.04 | 16.94 | 13.15 | 12.52 | 15.98 | 13.90 | 12.81 | 15.00 | 19.88 | 33.00 | 33.00 | 25.75 | 43.75 | 19.19 | 30.90 | 23.50 |
| November. | ..... | 14.00 | 16.87 | 21.37 | 18.12 | 14.72 | 17.25 | 13.25 | 12.42 | 16.37 | 13.09 | 12.48 | 15.75 | 25.10 | 33.00 | 33.00 | 28.31 | 36.50 | 19.00 | 27.75 | 20.88 |
| December.. | ..... | 15.70 | 16.75 | 21.50 | 17.50 | 15.60 | 17.05 | 13.40 | 12.25 | 16.50 | 12.71 | 12.50 | 17.50 | 30.00 | 33.00 | 33.00 | 34.25 | 33.00 | 18.63 | 24.81 | 21.00 |
| *Average..* | ..... | *12.59* | *15.26* | *18.10* | *20.87* | *15.16* | *15.48* | *14.76* | *13.07* | *13.92* | *14.71* | *12.87* | *13.74* | *19.76* | *38.90* | *32.58* | *27.65* | *42.21* | *21.74* | *24.80* | *25.81* |

*Southern No. 2 Foundry Pig Iron at Cincinnati, Dollars per Gross Ton*

| | | | | | | | | | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| January... | $21.65 | $12.37 | $16.25 | $16.75 | $26.00 | $16.15 | $16.25 | $17.25 | $14.25 | $13.25 | $16.95 | $13.88 | $12.40 | $17.90 | $26.10 | $35.90 | $34.60 | $41.80 | $36.75 | $20.70 | $27.45 |
| February... | 21.50 | 12.12 | 16.25 | 16.75 | 26.00 | 15.75 | 16.13 | 17.06 | 14.25 | 13.31 | 16.69 | 13.81 | 12.40 | 17.90 | 27.53 | 35.90 | 34.60 | 43.60 | 32.63 | 20.00 | 28.68 |
| March..... | 21.37 | 12.10 | 16.25 | 16.65 | 26.00 | 15.50 | 15.05 | 16.30 | 14.25 | 13.50 | 16.31 | 14.00 | 12.27 | 17.90 | 31.90 | 35.90 | 33.54 | 43.60 | 29.80 | 19.50 | 30.80 |
| April...... | 20.15 | 12.50 | 16.25 | 16.63 | 25.06 | 15.20 | 14.25 | 15.37 | 14.25 | 13.75 | 15.65 | 13.75 | 12.34 | 17.90 | 37.40 | 35.90 | 30.35 | 44.00 | 28.00 | 20.38 | 31.05 |
| May...... | 18.87 | 12.25 | 15.81 | 16.75 | 24.25 | 14.75 | 14.50 | 15.00 | 13.95 | 14.15 | 14.94 | 13.75 | 12.40 | 17.90 | 41.90 | 35.90 | 29.85 | 45.60 | 26.70 | 22.10 | 30.75 |
| June...... | 17.75 | 11.80 | 14.65 | 16.44 | 24.10 | 15.25 | 14.70 | 14.85 | 13.44 | 14.25 | 14.06 | 13.63 | 12.50 | 17.34 | 45.15 | 36.08 | 28.39 | 45.60 | 26.38 | 23.00 | 29.30 |
| July....... | 16.15 | 11.81 | 13.94 | 16.06 | 23.85 | 15.00 | 15.75 | 14.75 | 13.25 | 14.70 | 13.75 | 13.30 | 12.71 | 16.90 | 49.90 | 36.60 | 28.35 | 45.60 | 24.75 | 22.30 | 28.85 |
| August.... | 15.19 | 12.00 | 14.40 | 17.30 | 23.00 | 15.25 | 16.38 | 14.31 | 13.45 | 15.06 | 14.06 | 13.25 | 13.71 | 16.70 | 49.90 | 36.60 | 30.40 | 45.78 | 23.50 | 24.35 | 27.68 |
| September. | 14.75 | 12.00 | 14.37 | 18.69 | 21.50 | 15.65 | 17.35 | 14.25 | 13.31 | 15.87 | 14.25 | 13.25 | 14.15 | 17.28 | 49.90 | 36.60 | 31.25 | 46.50 | 23.50 | 29.55 | 26.55 |
| October.... | 13.50 | 12.81 | 15.31 | 20.00 | 20.95 | 15.75 | 17.88 | 14.25 | 13.25 | 16.80 | 14.35 | 12.90 | 14.78 | 18.03 | 49.38 | 37.60 | 31.60 | 46.50 | 23.50 | 30.85 | 24.68 |
| November. | 12.00 | 15.19 | 16.60 | 23.38 | 19.50 | 16.00 | 17.75 | 14.25 | 13.20 | 17.25 | 13.87 | 12.90 | 16.15 | 22.40 | 35.90 | 37.60 | 34.35 | 42.50 | 22.90 | 27.55 | 23.65 |
| December.. | 12.05 | 15.85 | 16.75 | 25.00 | 17.00 | 16.25 | 17.45 | 14.25 | 13.19 | 17.25 | 13.95 | 12.50 | 17.10 | 25.90 | 35.90 | 37.60 | 38.60 | 42.50 | 21.75 | 26.93 | 25.05 |
| *Average..* | *17.08* | *12.73* | *15.57* | *18.37* | *23.10* | *15.54* | *16.12* | *15.16* | *13.67* | *14.93* | *14.90* | *13.41* | *13.53* | *18.67* | *40.07* | *36.52* | *32.16* | *44.47* | *26.68* | *23.93* | *27.87* |

*Local No. 2 Foundry Pig Iron at Chicago (at Furnace), Dollars per Gross Ton*

| | | | | | | | | | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| January... | $23.45 | $14.47 | $17.85 | $19.60 | $25.85 | $18.45 | $17.35 | $19.00 | $15.50 | $14.00 | $17.90 | $13.75 | $13.00 | $18.50 | $30.00 | $33.00 | $31.00 | $40.00 | $31.50 | $18.90 | $28.90 |
| February... | 23.35 | 13.91 | 17.85 | 19.41 | 25.85 | 18.16 | 16.75 | 19.00 | 15.50 | 14.00 | 17.31 | 14.00 | 13.00 | 18.50 | 32.00 | 33.00 | 31.00 | 42.25 | 29.00 | 19.00 | 29.75 |
| March..... | 23.22 | 14.05 | 17.80 | 19.35 | 26.10 | 17.85 | 16.50 | 18.30 | 15.50 | 14.00 | 17.25 | 14.25 | 12.95 | 18.70 | 36.00 | 33.00 | 29.94 | 43.00 | 25.60 | 20.00 | 31.25 |
| April...... | 22.87 | 14.35 | 17.60 | 19.10 | 26.35 | 17.73 | 16.50 | 17.50 | 15.00 | 14.00 | 17.00 | 14.25 | 13.00 | 19.00 | 39.25 | 33.00 | 26.75 | 43.00 | 24.00 | 20.50 | 32.00 |
| May...... | 20.72 | 13.85 | 17.60 | 18.90 | 26.85 | 17.63 | 16.50 | 17.06 | 15.00 | 14.50 | 16.00 | 14.06 | 13.00 | 19.00 | 43.80 | 33.00 | 26.75 | 43.00 | 22.80 | 22.60 | 32.00 |
| June...... | 19.85 | 13.70 | 17.00 | 18.54 | 26.60 | 17.73 | 16.50 | 16.75 | 15.00 | 14.50 | 15.62 | 13.69 | 13.00 | 19.00 | 51.00 | 33.00 | 26.75 | 43.40 | 20.75 | 23.25 | 31.25 |
| July....... | 18.25 | 13.00 | 16.47 | 18.60 | 25.55 | 17.55 | 17.00 | 16.56 | 14.87 | 14.70 | 14.70 | 13.75 | 13.00 | 19.00 | 55.00 | 33.00 | 26.75 | 45.25 | 19.00 | 24.25 | 27.90 |
| August.... | 17.22 | 13.00 | 16.60 | 19.45 | 24.85 | 17.35 | 17.13 | 16.50 | 14.50 | 15.37 | 15.00 | 13.69 | 13.44 | 18.40 | 55.00 | 33.00 | 26.75 | 46.00 | 19.55 | 28.60 | 27.00 |
| September. | 16.41 | 13.85 | 16.60 | 20.16 | 24.10 | 17.05 | 18.70 | 16.40 | 14.50 | 16.00 | 15.00 | 13.25 | 13.90 | 18.13 | 54.67 | 33.00 | 26.75 | 46.00 | 21.75 | 32.00 | 26.75 |
| October.... | 15.70 | 14.10 | 17.66 | 21.48 | 22.45 | 16.85 | 19.00 | 16.00 | 14.46 | 17.00 | 15.00 | 12.94 | 14.63 | 19.63 | 33.00 | 34.00 | 27.75 | 44.50 | 21.00 | 31.40 | 25.00 |
| November. | 15.10 | 15.98 | 19.15 | 24.70 | 20.66 | 17.10 | 19.00 | 16.00 | 14.09 | 17.75 | 14.87 | 12.56 | 17.13 | 25.80 | 33.00 | 34.00 | 31.00 | 39.40 | 20.60 | 29.75 | 23.13 |
| December.. | 14.81 | 16.95 | 19.60 | 25.85 | 18.80 | 17.35 | 19.00 | 16.00 | 14.00 | 18.00 | 14.30 | 13.00 | 18.10 | 29.50 | 33.00 | 34.00 | 38.75 | 34.50 | 19.63 | 28.00 | 23.00 |
| *Average..* | *19.25* | *14.57* | *17.65* | *20.43* | *24.50* | *17.57* | *17.49* | *17.09* | *14.83* | *15.38* | *15.53* | *13.60* | *14.01* | *20.26* | *41.31* | *33.25* | *29.16* | *42.53* | *22.93* | *24.85* | *28.16* |

*Standard Brands Eastern Pennsylvania No. 2X Foundry Pig Iron at Philadelphia, Dollars per Gross Ton*

| | | | | | | | | | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| January... | $22.45 | $14.69 | $17.50 | $18.50 | $24.80 | $18.25 | $17.25 | $19.00 | $15.50 | $14.85 | $18.25 | $14.65 | $14.25 | $19.94 | $30.10 | $34.25 | $36.15 | $44.10 | $33.34 | $21.34 | $29.76 |
| February... | 22.25 | 14.50 | 17.50 | 18.50 | 25.87 | 18.25 | 17.00 | 18.69 | 15.50 | 14.85 | 18.25 | 14.94 | 14.25 | 20.00 | 31.88 | 34.25 | 36.15 | 45.10 | 31.09 | 21.09 | 30.01 |
| March..... | 22.25 | 14.80 | 17.56 | 18.35 | 25.00 | 18.12 | 16.37 | 18.00 | 15.50 | 14.92 | 17.77 | 15.00 | 14.25 | 20.05 | 37.31 | 34.25 | 34.39 | 45.53 | 27.59 | 21.26 | 32.30 |
| April...... | 21.87 | 15.00 | 17.75 | 18.44 | 24.81 | 17.65 | 16.20 | 17.75 | 15.50 | 15.00 | 17.40 | 15.00 | 14.25 | 20.50 | 41.38 | 34.25 | 31.90 | 46.85 | 26.26 | 23.62 | 32.95 |
| May...... | 20.06 | 14.75 | 17.81 | 18.50 | 25.55 | 16.94 | 16.06 | 17.00 | 15.50 | 15.18 | 16.75 | 14.81 | 14.25 | 20.50 | 43.60 | 34.25 | 30.70 | 47.10 | 25.71 | 26.09 | 32.76 |
| June...... | 19.19 | 14.50 | 16.75 | 18.44 | 24.62 | 16.62 | 16.42 | 16.55 | 15.25 | 15.31 | 16.19 | 14.75 | 14.25 | 19.94 | 48.19 | 34.29 | 29.50 | 47.15 | 25.50 | 27.06 | 30.76 |
| July....... | 18.10 | 14.31 | 16.12 | 18.25 | 23.06 | 16.50 | 16.50 | 16.25 | 15.00 | 15.70 | 15.60 | 14.75 | 14.31 | 19.75 | 53.13 | 34.40 | 29.08 | 48.15 | 23.55 | 27.92 | 27.68 |
| August.... | 16.87 | 14.25 | 16.25 | 19.00 | 21.90 | 16.50 | 17.00 | 16.00 | 15.00 | 15.87 | 15.60 | 14.75 | 14.94 | 19.55 | 53.00 | 34.40 | 29.00 | 51.96 | 20.64 | 32.26 | 25.89 |
| September. | 16.12 | 14.25 | 16.43 | 20.44 | 20.50 | 16.62 | 18.05 | 16.00 | 15.00 | 16.50 | 15.83 | 14.75 | 16.00 | 19.50 | 51.67 | 34.40 | 30.70 | 53.51 | 21.22 | 34.83 | 26.26 |
| October.... | 15.20 | 14.43 | 17.25 | 21.12 | 19.85 | 16.75 | 18.69 | 15.81 | 15.00 | 17.60 | 15.95 | 14.63 | 16.25 | 20.31 | 34.25 | 38.85 | 32.10 | 52.53 | 22.23 | 32.54 | 24.01 |
| November. | 15.00 | 15.75 | 18.05 | 23.30 | 18.94 | 17.00 | 19.00 | 15.68 | 14.95 | 18.25 | 15.56 | 14.50 | 17.12 | 24.90 | 34.25 | 39.15 | 35.35 | 44.99 | 22.74 | 30.39 | 23.01 |
| December.. | 15.00 | 16.90 | 18.25 | 24.00 | 18.84 | 17.25 | 19.00 | 15.50 | 14.85 | 18.25 | 15.20 | 14.25 | 19.05 | 29.25 | 34.25 | 39.15 | 40.10 | 35.54 | 21.82 | 28.86 | 24.26 |
| *Average..* | *18.70* | *14.84* | *17.27* | *19.74* | *22.81* | *17.20* | *17.50* | *16.85* | *15.21* | *16.03* | *16.53* | *14.73* | *15.26* | *21.18* | *41.08* | *35.49* | *32.98* | *46.88* | *25.14* | *27.27* | *28.31* |

*Mahoning and Shenango Valley No. 2 Foundry Iron, at Furnace, Dollars per Gross Ton*

| | | | | | | | | | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| January... | $22.30 | $13.00 | $16.12 | $17.31 | $24.60 | $16.80 | $15.44 | $17.00 | $13.75 | $13.00 | $17.50 | $12.85 | $13.00 | $18.50 | $31.00 | $33.00 | $31.00 | $39.40 | $31.88 | $19.30 | $27.00 |
| February.. | 21.95 | 12.47 | 16.00 | 17.25 | 24.12 | 16.00 | 15.06 | 16.69 | 13.75 | 13.00 | 17.00 | 13.19 | 13.00 | 18.31 | 32.00 | 33.00 | 31.00 | 41.50 | 28.00 | 18.88 | 27.50 |
| March.... | 22.00 | 12.91 | 16.00 | 17.12 | 24.00 | 15.56 | 14.50 | 16.10 | 13.75 | 13.12 | 16.69 | 13.25 | 13.00 | 18.50 | 34.75 | 33.00 | 29.94 | 41.25 | 25.90 | 19.00 | 30.50 |
| April...... | 20.99 | 13.01 | 16.00 | 16.50 | 24.00 | 15.15 | 14.00 | 15.62 | 13.75 | 13.25 | 15.55 | 13.25 | 12.75 | 18.50 | 39.75 | 33.00 | 26.75 | 42.80 | 24.75 | 20.75 | 31.00 |
| May...... | 20.32 | 12.47 | 15.55 | 16.30 | 25.00 | 14.87 | 14.19 | 15.31 | 13.75 | 13.25 | 14.62 | 13.00 | 12.94 | 18.20 | 42.40 | 33.00 | 26.75 | 44.25 | 23.50 | 23.80 | 30.20 |
| June...... | 19.37 | 11.96 | 14.81 | 16.19 | 25.12 | 15.00 | 14.90 | 14.75 | 13.56 | 13.25 | 14.06 | 13.00 | 12.69 | 18.13 | 50.25 | 33.00 | 26.75 | 45.00 | 22.10 | 24.00 | 27.63 |
| July...... | 18.02 | 11.67 | 14.25 | 16.44 | 22.80 | 14.80 | 15.19 | 14.31 | 13.50 | 13.37 | 13.87 | 13.00 | 12.70 | 18.25 | 54.50 | 33.00 | 26.75 | 45.00 | 20.13 | 24.25 | 25.50 |
| August.... | 16.34 | 11.87 | 14.15 | 17.71 | 22.50 | 14.50 | 15.31 | 14.15 | 13.50 | 13.69 | 14.00 | 13.00 | 13.62 | 18.25 | 53.20 | 33.00 | 26.75 | 47.00 | 19.63 | 32.60 | 24.88 |
| September. | 14.98 | 11.71 | 14.56 | 19.56 | 20.87 | 14.47 | 15.75 | 13.75 | 13.44 | 14.44 | 14.00 | 13.00 | 14.70 | 18.39 | 47.00 | 33.00 | 26.75 | 49.40 | 21.00 | 34.88 | 21.75 |
| October... | 14.09 | 12.50 | 15.50 | 21.35 | 19.80 | 14.36 | 17.12 | 13.94 | 13.37 | 16.10 | 13.84 | 12.90 | 14.87 | 20.00 | 33.00 | 34.00 | 26.75 | 46.50 | 21.00 | 31.80 | 23.60 |
| November. | 13.32 | 14.60 | 16.83 | 23.87 | 19.00 | 15.25 | 17.25 | 13.90 | 13.20 | 16.94 | 13.50 | 12.75 | 15.50 | 25.00 | 33.00 | 34.00 | 31.50 | 40.25 | 20.75 | 27.88 | 21.88 |
| December. | 13.22 | 16.19 | 17.35 | 24.00 | 17.37 | 15.50 | 17.00 | 13.75 | 13.00 | 17.25 | 13.50 | 12.75 | 18.30 | 30.75 | 33.00 | 34.00 | 36.75 | 36.20 | 20.00 | 25.63 | 22.00 |
| *Average..* | *18.08* | *12.86* | *15.59* | *18.63* | *22.43* | *15.19* | *15.48* | *14.94* | *13.53* | *14.22* | *14.84* | *13.00* | *13.92* | *20.07* | *40.32* | *33.25* | *28.95* | *43.21* | *23.22* | *25.23* | *26.37* |

## Gray Forge Pig Iron, Philadelphia and Vicinity, Gross Ton

| | 1903 | 1904 | 1905 | 1906 | 1907 | 1908 | 1909 | 1910 | 1911 | 1912 | 1913 | 1914 | 1915 | 1916 | 1917 | 1918 | 1919 | 1920 | 1921 | 1922 | 1923 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| January... | $21.75 | $13.50 | $16.25 | $16.75 | $23.50 | $16.50 | $16.25 | $17.25 | $14.25 | $14.25 | $17.65 | $14.00 | $13.50 | $18.44 | $28.38 | $32.00 | $33.90 | $40.23 | $32.78 | $20.60 | $27.85 |
| February.. | 21.25 | 13.50 | 15.75 | 17.00 | 23.50 | 16.50 | 16.25 | 17.50 | 14.25 | 14.25 | 17.31 | 14.00 | 13.44 | 19.00 | 29.75 | 32.00 | 33.90 | 40.50 | 30.90 | 20.50 | 28.37 |
| March.... | 20.00 | 12.75 | 16.25 | 16.75 | 23.50 | 16.50 | 15.50 | 16.90 | 14.60 | 14.25 | 16.87 | 14.00 | 13.25 | 19.00 | 31.94 | 32.00 | 32.84 | 43.00 | 26.86 | 20.50 | 29.62 |
| April...... | 20.00 | 13.75 | 16.25 | 16.75 | 23.00 | 16.00 | 15.00 | 16.62 | 14.75 | 14.37 | 16.56 | 14.00 | 13.25 | 19.13 | 38.50 | 32.00 | 29.65 | 43.00 | 25.26 | 21.25 | 30.37 |
| May...... | 19.50 | 13.75 | 16.00 | 16.50 | 23.25 | 16.00 | 15.00 | 16.00 | 14.70 | 14.50 | 15.81 | 13.81 | 13.25 | 19.50 | 40.40 | 32.00 | 29.21 | 43.00 | 25.26 | 23.80 | 29.50 |
| June...... | 18.25 | 13.50 | 15.75 | 16.25 | 23.00 | 15.25 | 15.25 | 15.65 | 14.50 | 14.62 | 15.37 | 13.75 | 13.25 | 19.25 | 44.31 | 32.00 | 26.25 | 43.00 | 24.69 | 24.25 | 28.00 |
| July...... | 18.12 | 13.25 | 14.50 | 16.10 | 22.50 | 15.25 | 15.50 | 15.37 | 14.50 | 14.87 | 14.95 | 13.75 | 13.25 | 18.50 | 50.05 | 32.00 | 25.92 | 43.00 | 22.50 | 25.50 | 26.90 |
| August.... | 15.50 | 12.50 | 15.00 | 16.50 | 20.50 | 15.25 | 16.25 | 15.00 | 14.30 | 15.37 | 14.62 | 13.75 | 14.50 | 18.50 | 49.56 | 32.00 | 26.60 | 45.46 | 21.20 | 29.00 | 25.50 |
| September. | 14.75 | 13.00 | 15.00 | 17.75 | 19.50 | 15.50 | 17.00 | 14.75 | 14.45 | 15.87 | 14.56 | 13.75 | 15.13 | 18.50 | 44.25 | 32.00 | 27.00 | 47.10 | 20.00 | 31.00 | 25.50 |
| October... | 14.50 | 12.75 | 15.75 | 18.25 | 18.75 | 15.50 | 17.50 | 14.50 | 14.25 | 16.87 | 15.00 | 13.62 | 15.25 | 19.35 | 32.20 | 36.60 | 28.69 | 47.10 | 20.50 | 31.00 | 24.20 |
| November. | 14.00 | 14.00 | 16.25 | 20.00 | 17.00 | 15.75 | 18.00 | 14.37 | 14.25 | 17.62 | 14.75 | 13.50 | 16.05 | 23.75 | 32.00 | 36.60 | 32.40 | 44.64 | 22.50 | 29.14 | 23.00 |
| December. | 14.00 | 15.50 | 16.50 | 22.00 | 16.75 | 16.00 | 18.00 | 14.25 | 14.25 | 17.75 | 14.58 | 13.50 | 17.63 | 27.69 | 32.00 | 36.90 | 36.10 | 38.74 | 21.69 | 28.14 | 23.00 |
| *Average..* | *17.64* | *13.48* | *15.77* | *17.55* | *21.23* | *15.83* | *16.29* | *15.67* | *14.42* | *15.33* | *15.67* | *13.79* | *14.31* | *20.05* | *37.78* | *33.18* | *30.21* | *43.23* | *24.51* | *25.39* | *26.82* |

## Malleable Pig Iron at Chicago, Dollars per Gross Ton

| | 1903 | 1904 | 1905 | 1906 | 1907 | *1908 | 1909 | 1910 | 1911 | 1912 | 1913 | 1914 | 1915 | 1916 | 1917 | 1918 | 1919 | 1920 | 1921 | 1922 | 1923 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| January... | $23.24 | $14.50 | $17.50 | $19.37 | $26.00 | $18.60 | $17.09 | $19.00 | $15.50 | $14.35 | $17.90 | $13.88 | $13.00 | $19.00 | $30.94 | $33.50 | $31.50 | $40.50 | $32.00 | $18.90 | $28.90 |
| February . | 23.00 | 14.50 | 17.50 | 19.19 | 26.00 | 18.25 | 16.75 | 19.00 | 15.50 | 14.14 | 17.31 | 13.94 | 13.00 | 19.00 | 31.75 | 33.50 | 31.50 | 42.75 | 29.38 | 19.13 | 29.75 |
| March.... | 22.87 | 14.00 | 17.50 | 19.00 | 26.25 | 17.50 | 16.50 | 18.40 | 15.50 | 14.00 | 17.25 | 14.25 | 13.00 | 19.40 | 35.40 | 33.50 | 30.44 | 43.50 | 25.80 | 20.00 | 31.25 |
| April..... | 21.82 | 14.00 | 17.50 | 18.77 | 26.50 | 17.50 | 16.50 | 17.50 | 15.25 | 14.00 | 17.05 | 14.25 | 13.00 | 19.50 | 39.00 | 33.50 | 27.25 | 43.50 | 24.00 | 20.50 | 32.00 |
| May...... | 20.77 | 14.00 | 17.37 | 18.35 | 26.60 | 17.56 | 16.66 | 17.06 | 15.00 | 14.40 | 16.00 | 14.06 | 13.00 | 19.50 | 43.60 | 33.50 | 27.25 | 43.50 | 23.00 | 22.60 | 32.00 |
| June...... | 19.50 | 13.85 | 16.65 | 18.00 | 26.25 | 17.37 | 16.50 | 16.75 | 15.00 | 14.50 | 15.62 | 13.88 | 13.00 | 19.50 | 50.25 | 33.50 | 27.25 | 43.50 | 21.50 | 23.25 | 31.25 |
| July...... | 18.66 | 13.75 | 16.37 | 18.37 | 25.62 | 17.50 | 16.90 | 16.56 | 15.00 | 14.50 | 14.65 | 14.00 | 13.00 | 19.50 | 55.00 | 33.50 | 27.25 | 45.25 | 10.00 | 24.25 | 27.90 |
| August .. | 17.59 | 13.75 | 16.50 | 18.95 | 24.80 | 17.50 | 17.12 | 16.50 | 14.80 | 15.10 | 15.00 | 14.00 | 13.44 | 19.00 | 55.00 | 33.50 | 27.25 | 46.50 | 19.60 | 28.60 | 27.00 |
| September | 16.94 | 13.50 | 16.56 | 20.12 | 24.40 | 17.26 | 18.50 | 16.40 | 14.50 | 16.25 | 15.00 | 13.25 | 14.30 | 19.00 | 54.75 | 33.50 | 27.25 | 46.50 | 21.75 | 32.00 | 26.75 |
| October... | 16.25 | 13.75 | 17.37 | 21.32 | 22.40 | 17.00 | 18.50 | 16.06 | 14.50 | 17.10 | 15.20 | 13.00 | 15.25 | 19.88 | 33.50 | 34.50 | 28.25 | 45.75 | 21.00 | 31.40 | 25.00 |
| November | 15.00 | 15.87 | 19.00 | 24.16 | 20.25 | 17.00 | 19.00 | 16.00 | 14.35 | 17.87 | 14.87 | 12.88 | 17.13 | 25.80 | 33.50 | 34.50 | 31.50 | 39.90 | 20.60 | 29.75 | 23.13 |
| December. | 14.50 | 16.50 | 19.50 | 26.00 | 18.75 | 17.00 | 19.00 | 16.00 | 14.35 | 18.00 | 14.63 | 12.90 | 18.20 | 29.50 | 33.50 | 34.50 | 39.50 | 35.00 | 19.63 | 28.00 | 23.00 |
| *Average.* | *19.18* | *14.33* | *17.44* | *20.13* | *24.49* | *17.50* | *17.42* | *17.10* | *14.94* | *15.35* | *15.87* | *13.69* | *14.11* | *20.72* | *41.35* | *33.75* | *29.68* | *43.01* | *23.11* | *24.87* | *28.16* |

*From this time on the prices are given as at furnace near Chicago, and 35c. to 50c. per ton should be added to get the price delivered to Chicago foundries.

## Lake Superior Charcoal Pig Iron at Chicago, Gross Ton

| | 1903 | 1904 | 1905 | 1906 | 1907 | 1908 | 1909 | 1910 | 1911 | 1912 | 1913 | 1914 | 1915 | 1916 | 1917 | 1918 | 1919 | 1920 | 1921 | 1922 | 1923 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| January... | $25.60 | $16.62 | $18.50 | $20.40 | $26.80 | $22.50 | $19.50 | $19.50 | $17.87 | $16.00 | $18.15 | $15.25 | $15.75 | $19.50 | $31.75 | $37.50 | $38.85 | $48.75 | $42.50 | $31.10 | $33.15 |
| February.. | 26.50 | 15.87 | 18.50 | 20.13 | 27.00 | 21.38 | 19.50 | 19.50 | 17.50 | 15.95 | 18.00 | 15.25 | 15.75 | 19.75 | 33.75 | 37.50 | 38.85 | 58.38 | 39.50 | 29.38 | 33.90 |
| March.... | 26.50 | 15.00 | 18.50 | 19.75 | 26.75 | 21.25 | 19.50 | 19.30 | 17.50 | 15.75 | 18.00 | 15.25 | 15.75 | 19.75 | 36.75 | 37.50 | 38.85 | 58.20 | 38.50 | 26.00 | 35.40 |
| April...... | 25.30 | 15.19 | 18.50 | 19.44 | 26.50 | 20.30 | 19.50 | 19.00 | 17.50 | 15.75 | 18.00 | 15.45 | 15.75 | 19.75 | 40.25 | 37.50 | 31.75 | 57.25 | 38.50 | 26.50 | 36.53 |
| May...... | 24.12 | 15.00 | 17.75 | 19.05 | 27.40 | 20.00 | 19.50 | 18.62 | 17.25 | 15.75 | 18.00 | 15.75 | 15.75 | 19.75 | 48.15 | 37.50 | 31.75 | 57.50 | 37.50 | 28.40 | 36.65 |
| June...... | 24.00 | 14.70 | 17.00 | 19.00 | 27.50 | 20.00 | 19.50 | 18.50 | 16.80 | 16.75 | 16.81 | 15.75 | 15.75 | 19.75 | 52.88 | 37.62 | 31.75 | 57.50 | 37.50 | 29.75 | 36.65 |
| July...... | 22.20 | 14.50 | 16.50 | 19.06 | 27.00 | 20.00 | 19.50 | 18.50 | 16.50 | 16.25 | 15.65 | 15.75 | 15.75 | 19.75 | 57.75 | 38.00 | 31.75 | 57.50 | 36.37 | 31.65 | 34.81 |
| August.... | 20.62 | 14.87 | 16.40 | 19.35 | 27.20 | 19.50 | 19.50 | 18.50 | 16.50 | 16.25 | 14.69 | 15.75 | 16.00 | 19.75 | 58.00 | 38.00 | 32.25 | 57.70 | 33.60 | 34.05 | 32.04 |
| September. | 19.00 | 14.75 | 16.87 | 20.13 | 27.00 | 19.50 | 19.50 | 18.40 | 16.50 | 17.12 | 15.25 | 15.75 | 15.85 | 19.75 | 58.00 | 38.00 | 32.75 | 58.50 | 33.00 | 36.15 | 32.01 |
| October... | 18.10 | 15.31 | 18.25 | 21.50 | 26.20 | 19.50 | 19.50 | 18.12 | 16.50 | 18.65 | 15.25 | 15.75 | 15.75 | 20.25 | 37.50 | 38.00 | 33.44 | 58.50 | 31.50 | 36.15 | 29.86 |
| November. | 17.12 | 16.37 | 19.20 | 24.63 | 25.12 | 19.50 | 19.50 | 18.00 | 16.50 | 18.65 | 15.25 | 15.75 | 17.00 | 26.46 | 37.50 | 38.70 | 38.50 | 55.75 | 31.50 | 36.15 | 28.40 |
| December. | 16.50 | 17.80 | 20.00 | 26.13 | 24.25 | 19.50 | 19.50 | 18.00 | 16.37 | 18.75 | 15.25 | 15.75 | 18.65 | 31.75 | 37.50 | 38.70 | 43.00 | 49.13 | 31.50 | 34.65 | 29.15 |
| *Average..* | *22.13* | *15.50* | *18.00* | *20.71* | *26.56* | *20.24* | *19.50* | *18.66* | *16.94* | *16.80* | *16.53* | *15.60* | *16.13* | *21.33* | *44.15* | *37.88* | *35.29* | *56.22* | *35.96* | *31.66* | *33.22* |

## Southern No. 2 Foundry Pig Iron at Birmingham, Dollars per Gross Ton

| | 1903 | 1904 | 1905 | 1906 | 1907 | 1908 | 1909 | 1910 | 1911 | 1912 | 1913 | 1914 | 1915 | 1916 | 1917 | 1918 | 1919 | 1920 | 1921 | 1922 | 1923 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| January .. | $20.00 | $ 9.94 | $13.94 | $14.50 | $23.10 | $13.65 | $13.00 | $14.13 | $11.00 | $10.00 | $13.56 | $10.63 | $ 9.50 | $15.00 | $23.20 | $33.00 | $31.00 | $38.75 | $32.25 | $16.20 | $23.25 |
| February.. | 18.88 | 9.69 | 13.94 | 14.25 | 22.25 | 13.50 | 13.00 | 14.00 | 11.00 | 10.06 | 13.38 | 10.56 | 9.50 | 15.00 | 24.63 | 33.00 | 31.00 | 40.00 | 28.13 | 15.00 | 24.38 |
| March.... | 18.38 | 9.55 | 13.85 | 14.37 | 22.50 | 13.00 | 12.50 | 13.42 | 11.00 | 10.25 | 13.06 | 10.70 | 9.35 | 15.00 | 29.00 | 33.00 | 29.44 | 40.00 | 25.30 | 15.00 | 26.40 |
| April..... | 17.00 | 10.00 | 13.56 | 14.00 | 22.50 | 12.15 | 11.40 | 12.75 | 11.00 | 10.55 | 12.40 | 10.50 | 9.44 | 15.00 | 34.50 | 33.00 | 26.75 | 40.50 | 23.50 | 15.88 | 27.00 |
| May...... | 16.44 | 9.75 | 13.19 | 14.00 | 22.70 | 11.63 | 11.38 | 12.00 | 10.70 | 10.94 | 11.69 | 10.50 | 9.44 | 15.00 | 39.00 | 33.00 | 26.75 | 42.00 | 22.20 | 17.60 | 26.85 |
| June...... | 14.75 | 9.35 | 12.70 | 13.81 | 22.50 | 12.00 | 11.50 | 12.00 | 10.19 | 11.00 | 10.81 | 10.35 | 9.65 | 14.50 | 42.25 | 33.00 | 25.25 | 42.00 | 21.88 | 18.38 | 25.75 |
| July...... | 13.70 | 9.50 | 11.63 | 13.56 | 21.19 | 11.90 | 12.45 | 12.00 | 10.00 | 11.45 | 10.50 | 10.00 | 9.75 | 14.00 | 47.00 | 33.00 | 25.15 | 42.00 | 20.25 | 18.25 | 25.00 |
| August.... | 12.75 | 9.50 | 12.00 | 14.55 | 20.40 | 12.38 | 13.25 | 11.50 | 10.20 | 11.81 | 10.81 | 10.00 | 10.75 | 13.80 | 47.00 | 33.00 | 27.38 | 42.00 | 19.00 | 20.10 | 23.70 |
| September. | 12.00 | 9.50 | 12.00 | 15.63 | 18.50 | 13.19 | 14.00 | 11.50 | 10.06 | 12.75 | 11.00 | 10.00 | 11.50 | 14.38 | 47.00 | 33.00 | 27.95 | 42.00 | 19.00 | 26.00 | 22.75 |
| October... | 11.06 | 10.90 | 13.00 | 15.87 | 18.50 | 13.00 | 15.00 | 11.50 | 10.00 | 13.50 | 11.25 | 10.00 | 12.13 | 15.50 | 33.00 | 34.00 | 28.00 | 42.00 | 19.00 | 26.80 | 20.63 |
| November. | 9.69 | 12.50 | 14.25 | 20.90 | 18.00 | 13.00 | 15.00 | 11.00 | 9.94 | 14.00 | 10.63 | 10.00 | 13.40 | 20.13 | 33.00 | 34.00 | 30.75 | 38.00 | 18.40 | 23.50 | 19.60 |
| December. | 9.50 | 13.69 | 14.50 | 22.56 | 15.00 | 13.00 | 14.40 | 11.00 | 9.94 | 14.00 | 10.70 | 9.60 | 14.38 | 23.00 | 33.00 | 33.40 | 35.20 | 38.00 | 17.33 | 22.88 | 21.00 |
| *Average..* | *14.51* | *10.32* | *13.21* | *15.67* | *20.59* | *12.70* | *13.07* | *12.23* | *10.42* | *11.69* | *11.65* | *10.24* | *10.73* | *15.86* | *36.05* | *33.20* | *28.72* | *40.60* | *22.19* | *19.63* | *23.86* |

# THE IRON AGE Composite Iron and Steel Prices

## Composite Pig Iron Price

*Average of* THE IRON AGE *quotations on foundry and basic pig irons; basic iron at Valley furnace; foundry iron an average of Chicago, Birmingham and Philadelphia. Quoted in dollars per gross ton.*

| | 1903 | 1904 | 1905 | 1906 | 1907 | 1908 | 1909 | 1910 | 1911 | 1912 | 1913 | 1914 | 1915 | 1916 | 1917 | 1918 | 1919 | 1920 | 1921 | 1922 | 1923 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| January... | $22.06 | $13.47 | $15.95 | $17.30 | $23.24 | $16.84 | $15.68 | $17.12 | $13.63 | $12.65 | $16.49 | $12.76 | $12.38 | $17.81 | $28.88 | $33.21 | $31.36 | $39.08 | $31.18 | $18.48 | $26.78 |
| February.. | 21.47 | 13.17 | 15.84 | 17.10 | 23.33 | 16.30 | 15.35 | 16.77 | 13.83 | 12.61 | 16.31 | 13.18 | 12.38 | 17.76 | 29.75 | 33.21 | 31.36 | 42.35 | 28.45 | 18.14 | 27.20 |
| March.... | 21.54 | 13.43 | 15.98 | 17.10 | 23.02 | 15.97 | 15.03 | 16.29 | 13.88 | 12.93 | 16.07 | 13.16 | 12.34 | 18.06 | 32.18 | 33.21 | 30.10 | 42.17 | 25.18 | 18.35 | 30.11 |
| April...... | 20.93 | 13.65 | 15.68 | 17.03 | 23.03 | 15.55 | 14.38 | 15.97 | 13.79 | 13.09 | 15.74 | 13.13 | 12.37 | 18.15 | 38.56 | 32.71 | 27.11 | 42.93 | 23.73 | 20.00 | 30.83 |
| May...... | 19.54 | 13.19 | 15.68 | 17.07 | 23.97 | 15.16 | 14.38 | 15.27 | 13.53 | 13.27 | 14.98 | 13.06 | 12.37 | 18.08 | 41.87 | 32.71 | 26.91 | 43.64 | 22.78 | 23.35 | 29.74 |
| June ..... | 18.83 | 12.66 | 15.04 | 16.94 | 23.47 | 15.35 | 14.71 | 14.90 | 13.27 | 13.36 | 14.35 | 12.97 | 12.45 | 17.91 | 47.95 | 32.71 | 26.46 | 44.09 | 21.73 | 23.95 | 28.23 |
| July...... | 17.79 | 11.84 | 14.37 | 16.96 | 22.51 | 14.91 | 15.18 | 14.72 | 13.21 | 13.68 | 13.99 | 12.92 | 12.55 | 17.79 | 52.11 | 32.73 | 26.37 | 45.44 | 20.22 | 23.86 | 25.96 |
| August.... | 16.98 | 12.07 | 14.64 | 17.68 | 21.82 | 15.05 | 15.52 | 14.39 | 13.12 | 14.15 | 13.93 | 12.91 | 13.55 | 17.63 | 51.43 | 32.73 | 26.83 | 47.38 | 18.97 | 26.69 | 25.19 |
| September. | 16.03 | 12.07 | 14.94 | 18.59 | 20.55 | 15.03 | 16.41 | 14.17 | 12.99 | 14.74 | 13.97 | 12.83 | 14.28 | 17.82 | 46.93 | 32.73 | 27.11 | 47.83 | 19.89 | 31.78 | 25.02 |
| October... | 15.02 | 12.67 | 15.61 | 19.52 | 19.88 | 14.79 | 17.25 | 13.79 | 12.84 | 16.01 | 13.93 | 12.67 | 14.67 | 19.18 | 33.21 | 34.31 | 27.52 | 45.05 | 19.97 | 30.57 | 23.30 |
| November. | 14.23 | 14.37 | 17.01 | 22.17 | 18.66 | 15.21 | 17.46 | 13.74 | 12.71 | 16.52 | 13.89 | 12.42 | 15.82 | 24.36 | 33.21 | 34.36 | 30.34 | 38.65 | 19.79 | 27.82 | 21.40 |
| December. | 13.75 | 15.77 | 17.10 | 22.82 | 17.52 | 15.73 | 17.26 | 13.78 | 12.59 | 16.63 | 13.06 | 12.39 | 17.34 | 28.63 | 33.21 | 34.26 | 36.13 | 34.51 | 19.11 | 25.70 | 21.88 |
| *Average..* | *18.18* | *13.20* | *15.65* | *18.36* | *21.75* | *15.49* | *15.72* | *15.03* | *13.28* | *14.14* | *14.63* | *12.87* | *13.54* | *19.43* | *36.11* | *33.24* | *28.97* | *42.76* | *22.53* | *24.06* | *26.30* |

## Composite Price of Finished Steel

*Average of* THE IRON AGE *quotations on steel bars, beams, tank plates, plain wire, open-hearth rails, black pipe and black sheets. Quoted in cents per pound.*

| | 1903 | 1904 | 1905 | 1906 | 1907 | 1908 | 1909 | 1910 | 1911 | 1912 | 1913 | 1914 | 1915 | 1916 | 1917 | 1918 | 1919 | 1920 | 1921 | 1922 | 1923 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| January... | 1.921 | 1.740 | 1.713 | 1.747 | 1.887 | 1.923 | 1.82 | 1.741 | 1.615 | 1.424 | 1.771 | 1.451 | 1.383 | 2.06 | 3.384 | 3.549 | 3.371 | 3.158 | 3.057 | 2.059 | 2.469 |
| February.. | 1.875 | 1.751 | 1.725 | 1.749 | 1.899 | 1.92 | 1.772 | 1.736 | 1.63 | 1.40 | 1.760 | 1.477 | 1.395 | 2.203 | 3.501 | 3.549 | 3.371 | 3.486 | 2.918 | 2.007 | 2.605 |
| March.... | 1.886 | 1.769 | 1.783 | 1.746 | 1.905 | 1.92 | 1.599 | 1.727 | 1.623 | 1.394 | 1.786 | 1.473 | 1.413 | 2.447 | 3.739 | 3.549 | 3.282 | 3.743 | 2.704 | 2.014 | 2.721 |
| April...... | 1.886 | 1.764 | 1.793 | 1.741 | 1.931 | 1.92 | 1.577 | 1.727 | 1.627 | 1.433 | 1.79 | 1.446 | 1.437 | 2.611 | 4.110 | 3.549 | 3.031 | 3.842 | 2.737 | 2.075 | 2.814 |
| May...... | 1.886 | 1.757 | 1.799 | 1.741 | 1.933 | 1.92 | 1.506 | 1.72 | 1.62 | 1.456 | 1.727 | 1.424 | 1.433 | 2.75 | 4.502 | 3.549 | 3.021 | 3.804 | 2.764 | 2.113 | 2.793 |
| June...... | 1.886 | 1.737 | 1.779 | 1.763 | 1.927 | 1.851 | 1.506 | 1.707 | 1.556 | 1.47 | 1.687 | 1.390 | 1.444 | 2.689 | 5.004 | 3.549 | 3.021 | 3.756 | 2.643 | 2.148 | 2.789 |
| July...... | 1.884 | 1.702 | 1.779 | 1.763 | 1.927 | 1.82 | 1.543 | 1.657 | 1.546 | 1.504 | 1.667 | 1.40 | 1.471 | 2.64 | 5.334 | 3.549 | 3.021 | 3.885 | 2.455 | 2.169 | 2.783 |
| August.... | 1.879 | 1.674 | 1.783 | 1.763 | 1.927 | 1.82 | 1.581 | 1.636 | 1.539 | 1.553 | 1.624 | 1.446 | 1.511 | 2.682 | 5.249 | 3.549 | 3.021 | 3.967 | 2.341 | 2.292 | 2.775 |
| September. | 1.871 | 1.621 | 1.786 | 1.763 | 1.934 | 1.82 | 1.616 | 1.627 | 1.513 | 1.61 | 1.591 | 1.47 | 1.559 | 2.765 | 5.049 | 3.549 | 3.004 | 3.956 | 2.248 | 2.410 | 2.775 |
| October... | 1.867 | 1.620 | 1.72 | 1.78 | 1.934 | 1.82 | 1.664 | 1.613 | 1.441 | 1.659 | 1.559 | 1.446 | 1.634 | 2.856 | 3.470 | 3.55 | 3.052 | 3.81 | 2.218 | 2.461 | 2.775 |
| November. | 1.813 | 1.652 | 1.723 | 1.82 | 1.934 | 1.82 | 1.674 | 1.613 | 1.407 | 1.70 | 1.505 | 1.397 | 1.769 | 3.021 | 3.444 | 3.549 | 3.084 | 3.566 | 2.129 | 2.445 | 2.775 |
| December. | 1.761 | 1.691 | 1.727 | 1.87 | 1.934 | 1.82 | 1.727 | 1.611 | 1.399 | 1.725 | 1.463 | 1.366 | 1.941 | 3.278 | 3.441 | 3.401 | 3.11 | 3.114 | 2.107 | 2.439 | 2.775 |
| *Average..* | *1.868* | *1.707* | *1.759* | *1.77* | *1.923* | *1.864* | *1.632* | *1.662* | *1.542* | *1.529* | *1.663* | *1.434* | *1.534* | *2.671* | *4.188* | *3.542* | *3.115* | *3.675* | *2.532* | *2.220* | *2.738* |

# Billets and Finished Steel

### *Bessemer Steel Billets at Pittsburgh, Dollars per Gross Ton*

| | 1903 | 1904 | 1905 | 1906 | 1907 | 1908 | 1909 | 1910 | 1911 | 1912 | 1913 | 1914 | 1915 | 1916 | 1917 | 1918 | 1919 | 1920 | 1921 | 1922 | 1923 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| January... | $29.60 | $23.00 | $22.75 | $26.25 | $29.40 | $28.00 | $25.00 | $27.50 | $23.00 | $20.00 | $28.30 | $20.13 | $19.25 | $32.00 | $63.00 | $47.50 | $43.50 | $48.00 | $43.50 | $28.00 | $37.30 |
| February.. | 29.87 | 23.00 | 23.50 | 26.50 | 29.50 | 28.00 | 25.00 | 27.50 | 23.00 | 20.00 | 28.50 | 21.00 | 19.50 | 33.50 | 65.00 | 47.50 | 43.50 | 55.25 | 42.25 | 28.00 | 39.63 |
| March.... | 30.62 | 23.00 | 24.00 | 26.70 | 29.00 | 28.00 | 23.00 | 27.50 | 23.00 | 19.75 | 28.50 | 21.00 | 19.70 | 42.40 | 66.25 | 47.50 | 42.25 | 60.00 | 38.40 | 28.00 | 44.38 |
| April...... | 30.25 | 23.00 | 24.00 | 27.00 | 30.12 | 28.00 | 23.00 | 26.75 | 23.00 | 20.00 | 28.50 | 20.80 | 20.00 | 45.00 | 73.75 | 47.50 | 38.50 | 60.00 | 37.50 | 29.50 | 45.00 |
| May...... | 30.37 | 23.00 | 23.50 | 26.40 | 30.30 | 28.00 | 23.00 | 26.12 | 22.60 | 20.80 | 27.37 | 20.00 | 20.00 | 45.00 | 86.00 | 47.50 | 38.50 | 60.00 | 37.00 | 34.00 | 44.60 |
| June...... | 28.87 | 23.00 | 22.00 | 26.63 | 29.62 | 25.75 | 23.00 | 25.30 | 21.00 | 20.87 | 26.50 | 19.50 | 20.50 | 43.50 | 98.75 | 47.50 | 38.50 | 61.00 | 37.00 | 35.00 | 42.63 |
| July...... | 27.60 | 23.00 | 22.00 | 27.25 | 30.00 | 25.00 | 23.50 | 25.00 | 21.00 | 21.50 | 26.60 | 19.00 | 21.38 | 41.00 | 100.00 | 47.50 | 38.50 | 62.50 | 32.25 | 35.00 | 42.50 |
| August.... | 27.00 | 23.00 | 24.00 | 27.80 | 29.25 | 25.00 | 24.13 | 24.63 | 21.00 | 22.12 | 26.00 | 20.25 | 23.13 | 44.20 | 86.00 | 47.50 | 38.50 | 61.00 | 29.60 | 36.10 | 42.50 |
| September. | 27.00 | 20.00 | 25.00 | 28.00 | 29.37 | 25.00 | 25.00 | 24.40 | 20.75 | 23.62 | 24.87 | 21.00 | 24.10 | 45.00 | 66.25 | 47.50 | 38.50 | 58.74 | 29.00 | 39.50 | 41.88 |
| October... | 27.00 | 19.50 | 25.62 | 28.00 | 28.20 | 25.00 | 26.25 | 23.75 | 20.00 | 26.00 | 23.30 | 20.00 | 24.63 | 46.25 | 49.38 | 47.50 | 38.50 | 55.00 | 29.00 | 40.00 | 40.00 |
| November. | 24.00 | 20.25 | 26.00 | 28.88 | 28.00 | 25.00 | 27.13 | 23.30 | 19.50 | 27.00 | 21.00 | 19.25 | 26.50 | 52.00 | 47.50 | 47.50 | 41.38 | 49.70 | 29.00 | 37.75 | 40.00 |
| December. | 23.00 | 21.20 | 26.00 | 29.50 | 28.00 | 25.00 | 27.50 | 23.00 | 19.25 | 27.00 | 20.00 | 19.00 | 30.60 | 57.50 | 47.50 | 45.50 | 46.00 | 43.50 | 29.00 | 36.50 | 40.00 |
| *Average..* | *27.93* | *22.08* | *24.03* | *27.41* | *29.23* | *26.31* | *24.61* | *25.40* | *21.43* | *22.39* | *25.79* | *20.08* | *22.44* | *43.95* | *70.78* | *47.33* | *40.51* | *56.22* | *34.46* | *33.95* | *41.70* |

### *Wire Rod Prices at Pittsburgh for Twenty-one Years*

**No. 5 Bessemer wire rods, per gross ton. The quotations for November and December, 1917, and all of 1918, are Government prices and apply also to open-hearth rods.**

| | 1903 | 1904 | 1905 | 1906 | 1907 | 1908 | 1909 | 1910 | 1911 | 1912 | 1913 | 1914 | 1915 | 1916 | 1917 | 1918 | 1919 | 1920 | 1921 | 1922 | 1923 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| January... | $34.70 | $30.00 | $31.00 | $33.75 | $37.00 | $34.30 | $33.00 | $33.00 | $28.00 | $24.37 | $30.00 | $25.50 | $25.00 | $43.00 | $75.00 | $57.00 | $57.00 | $60.00 | $57.00 | $36.00 | $47.00 |
| February.. | 35.75 | 30.00 | 31.00 | 34.00 | 37.00 | 35.00 | 33.00 | 33.00 | 28.75 | 25.00 | 30.00 | 26.38 | 25.00 | 48.00 | 77.50 | 57.00 | 57.00 | 63.75 | 54.50 | 35.75 | 49.38 |
| March.... | 36.62 | 30.80 | 31.70 | 34.00 | 37.00 | 35.00 | 33.00 | 33.00 | 29.00 | 25.00 | 30.00 | 26.50 | 25.00 | 54.80 | 81.00 | 57.00 | 55.75 | 70.00 | 52.00 | 36.00 | 50.00 |
| April...... | 37.00 | 31.00 | 34.00 | 34.12 | 37.00 | 35.00 | 29.00 | 32.50 | 29.00 | 25.00 | 30.00 | 26.00 | 25.00 | 60.00 | 85.00 | 57.00 | 52.00 | 70.00 | 40.00 | 38.00 | 50.25 |
| May...... | 37.00 | 30.50 | 34.00 | 34.40 | 37.00 | 35.00 | 27.50 | 32.00 | 29.00 | 25.00 | 30.00 | 25.50 | 25.00 | 60.00 | 86.00 | 57.00 | 52.00 | 72.50 | 48.00 | 38.00 | 51.00 |
| June...... | 36.62 | 29.20 | 33.30 | 34.00 | 37.12 | 33.50 | 27.50 | 30.80 | 28.25 | 25.00 | 29.50 | 24.50 | 25.00 | 53.75 | 92.50 | 57.00 | 52.00 | 75.00 | 48.00 | 38.50 | 51.00 |
| July...... | 35.80 | 28.00 | 31.87 | 34.00 | 36.50 | 33.00 | 29.40 | 29.25 | 27.00 | 25.00 | 28.30 | 24.50 | 25.63 | 53.75 | 96.25 | 57.00 | 52.00 | 75.00 | 43.00 | 40.00 | 51.00 |
| August.... | 35.00 | 28.00 | 32.10 | 34.00 | 36.10 | 33.25 | 31.00 | 28.25 | 27.00 | 25.80 | 28.00 | 25.00 | 27.00 | 55.00 | 94.00 | 57.00 | 52.00 | 75.00 | 41.80 | 42.40 | 51.00 |
| September. | 34.75 | 27.00 | 31.12 | 34.00 | 36.00 | 33.00 | 31.50 | 28.00 | 27.00 | 27.00 | 27.37 | 26.20 | 29.40 | 55.00 | 88.75 | 57.00 | 52.00 | 75.00 | 39.50 | 46.25 | 51.00 |
| October... | 34.00 | 26.00 | 31.75 | 34.50 | 35.40 | 33.00 | 31.87 | 28.50 | 26.00 | 28.50 | 26.60 | 25.88 | 31.75 | 55.00 | 77.25 | 57.00 | 52.00 | 75.00 | 40.50 | 45.00 | 51.00 |
| November. | 31.62 | 26.75 | 32.10 | 35.50 | 34.00 | 33.00 | 32.50 | 28.12 | 25.30 | 29.75 | 25.87 | 25.25 | 36.25 | 63.00 | 57.00 | 57.00 | 54.50 | 66.40 | 40.00 | 45.00 | 51.00 |
| December.. | 30.50 | 29.80 | 32.50 | 37.00 | 34.00 | 33.00 | 33.00 | 28.00 | 24.50 | 30.00 | 25.17 | 25.00 | 39.50 | 68.75 | 57.00 | 57.00 | 59.50 | 57.00 | 38.00 | 45.00 | 51.00 |
| *Average..* | *34.95* | *28.92* | *32.20* | *34.44* | *36.18* | *33.84* | *31.02* | *30.37* | *27.40* | *26.29* | *28.40* | *25.52* | *28.29* | *55.84* | *79.77* | *57.00* | *53.98* | *69.55* | *45.94* | *40.49* | *50.39* |

### *Steel Rails at Mill, Dollars per Gross Ton*

*Bessemer rails to end of 1913; open-hearth rails from beginning of 1914*

*The extra $2 per gross ton, which has for many years been charged for open-hearth rails, was annulled with the rail price announced Oct. 22, 1921*

| | 1903 | 1904 | 1905 | 1906 | 1907 | 1908 | 1909 | 1910 | 1911 | 1912 | 1913 | 1914 | 1915 | 1916 | 1917 | 1918 | 1919 | 1920 | 1921 | 1922 | 1923 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| January... | $28.00 | $28.00 | $28.00 | $28.00 | $28.00 | $28.00 | $28.00 | $28.00 | $28.00 | $28.00 | $28.00 | $30.00 | $30.00 | $30.00 | $40.00 | $57.00 | $57.00 | $47.00 | $47.00 | $40 00 | $43.00 |
| February.. | 28.00 | 28.00 | 28.00 | 28.00 | 28.00 | 28.00 | 28.00 | 28.00 | 28.00 | 28.00 | 28.00 | 30.00 | 30.00 | 30.00 | 40.00 | 57.00 | 57.00 | 47.00 | 47.00 | 40.00 | 43.00 |
| March.... | 28.00 | 28.00 | 28.00 | 28.00 | 28.00 | 28.00 | 28.00 | 28.00 | 28.00 | 28.00 | 28.00 | 30.00 | 30.00 | 30.00 | 40.00 | 57.00 | 54.50 | 49.50 | 47.00 | 40.00 | 43.00 |
| April...... | 28.00 | 28.00 | 28.00 | 28.00 | 28.00 | 28.00 | 28.00 | 28.00 | 28.00 | 28.00 | 28.00 | 30.00 | 30.00 | 30.00 | 40.00 | 57.00 | 47.00 | 57.00 | 47.00 | 40.00 | 43.00 |
| May...... | 28.00 | 28.00 | 28.00 | 28.00 | 28.00 | 28.00 | 28.00 | 28.00 | 28.00 | 28.00 | 28.00 | 30.00 | 30.00 | 35.00 | 40.00 | 57.00 | 47.00 | 57.00 | 47.00 | 40.00 | 43.00 |
| June...... | 28.00 | 28.00 | 28.00 | 28.00 | 28.00 | 28.00 | 28.00 | 28.00 | 28.00 | 28.00 | 28.00 | 30.00 | 30.00 | 35.00 | 40.00 | 57.00 | 47.00 | 57.00 | 47.00 | 40.00 | 43.00 |
| July...... | 28.00 | 28.00 | 28.00 | 28.00 | 28.00 | 28.C0 | 28.00 | 28.00 | 28.00 | 28.00 | 28.00 | 30.00 | 30.00 | 35.00 | 40.00 | 57.00 | 47.00 | 57.00 | 47.00 | 40.00 | 43.00 |
| August.... | 28:00 | 28.00 | 28.00 | 28.00 | 28.00 | 28.00 | 28.00 | 28.00 | 28.00 | 28.00 | 28.00 | 30.00 | 30.00 | 35.00 | 40.00 | 57.00 | 47.00 | 57.00 | 47.00 | 40.00 | 43.00 |
| September | 28.00 | 28.00 | 28.00 | 28.00 | 28.00 | 28.00 | 28.00 | 28.00 | 28.00 | 28.00 | 28.00 | 30.00 | 30.00 | 35.00 | 40.00 | 57.00 | 47.00 | 57.00 | 47 C0 | 40.00 | 43.00 |
| October... | 28.00 | 28.00 | 28.00 | 28.00 | 28.00 | 28.00 | 28.00 | 28.00 | 28.00 | 28.00 | 28.00 | 30.00 | 30.00 | 35.00 | ..... | 57.00 | 47.00 | 57.00 | 45.25 | 43.00 | 43.00 |
| November. | 28.00 | 28.00 | 28.00 | 28.00 | 28.00 | 28.00 | 28.00 | 28.00 | 28.00 | 28.00 | 28.00 | 30.00 | 30.00 | 38.00 | ..... | 57.00 | 47.00 | 57.00 | 40.00 | 43 00 | 43.00 |
| December. | 28.00 | 28.00 | 28.00 | 28.00 | 28.00 | 28.00 | 28.00 | 28.00 | 28.00 | 28.00 | 28.00 | 30.00 | 30.00 | 40.00 | ..... | 57.00 | 47.00 | 53.00 | 40.00 | 43.00 | 43.00 |
| *Average..* | *28.00* | *28.00* | *28.00* | *28.00* | *28.00* | *28.00* | *28.00* | *28.00* | *28.00* | *28.00* | *28.00* | *30.00* | *30.00* | *34.00* | *40.00* | *57.00* | *49.29* | *54.38* | *45.69* | *40.75* | *43.00* |

### *Soft Steel Bars at Pittsburgh, Cents per Pound*

| | 1903 | 1904 | 1905 | 1906 | 1907 | 1908 | 1909 | 1910 | 1911 | 1912 | 1913 | 1914 | 1915 | 1916 | 1917 | 1918 | 1919 | 1920 | 1921 | 1922 | 1923 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| January... | 1.60 | 1.30 | 1.40 | 1.50 | 1.60 | 1.60 | 1.40 | 1.50 | 1.40 | 1.15 | 1.70 | 1.20 | 1.10 | 2.03 | 3.15 | 2.90 | 2.70 | 2.75 | 2.35 | 1.50 | 2.04 |
| February.. | 1.60 | 1.30 | 1.40 | 1.50 | 1.60 | 1.60 | 1.35 | 1.50 | 1.40 | 1.12 | 1.70 | 1.20 | 1.10 | 2.31 | 3.25 | 2.90 | 2.70 | 3.00 | 2.15 | 1.39 | 2.20 |
| March.... | 1.60 | 1.33 | 1.50 | 1.50 | 1.60 | 1.60 | 1.20 | 1.45 | 1.40 | 1.10 | 1.85 | 1.20 | 1.15 | 2.65 | 3.63 | 2.90 | 2.61 | 3.63 | 2.00 | 1.39 | 2.39 |
| April...... | 1.60 | 1.35 | 1.50 | 1.50 | 1.60 | 1.60 | 1.15 | 1.45 | 1.40 | 1.16 | 1.84 | 1.15 | 1.20 | 2.88 | 3.75 | 2.90 | 2.35 | 3.75 | 2.05 | 1.50 | 2.50 |
| May...... | 1.60 | 1.35 | 1.50 | 1.50 | 1.60 | 1.60 | 1.19 | 1.45 | 1.37 | 1.20 | 1.70 | 1.14 | 1.20 | 3.00 | 4.00 | 2.90 | 2.35 | 3.63 | 2.10 | 1.58 | 2.40 |
| June...... | 1.60 | 1.35 | 1.46 | 1.50 | 1.60 | 1.45 | 1.20 | 1.45 | 1.25 | 1.20 | 1.60 | 1.11 | 1.21 | 2.75 | 4.25 | 2.90 | 2.35 | 3.50 | 2.05 | 1.70 | 2.40 |
| July...... | 1.60 | 1.35 | 1.50 | 1.50 | 1.60 | 1.40 | 1.27 | 1.45 | 1.23 | 1.25 | 1.50 | 1.12 | 1.35 | 2.63 | 4.50 | 2.90 | 2.35 | 3.50 | 1.84 | 1.70 | 2.40 |
| August.... | 1.60 | 1.35 | 1.50 | 1.50 | 1.60 | 1.40 | 1.32 | 1.40 | 1.20 | 1.30 | 1.40 | 1.19 | 1.30 | 2.56 | 4.30 | 2.90 | 2 35 | 3 25 | 1.74 | 1.88 | 2.40 |
| September. | 1.60 | 1.31 | 1.50 | 1.50 | 1.60 | 1.40 | 1.39 | 1.40 | 1.19 | 1.37 | 1.40 | 1.20 | 1.34 | 2.60 | 4.00 | 2.90 | 2.35 | 3.25 | 1.63 | 2.00 | 2.40 |
| October... | 1.60 | 1.30 | 1.50 | 1.50 | 1.60 | 1.40 | 1.51 | 1.40 | 1.12 | 1.45 | 1.39 | 1.15 | 1.44 | 2.75 | 2.90 | 2.90 | 2.39 | 3.13 | 1.55 | 2.00 | 2.40 |
| November. | 1.37 | 1.31 | 1.50 | 1.54 | 1.60 | 1.40 | 1.50 | 1.40 | 1.08 | 1.55 | 1.29 | 1.10 | 1.62 | 2.83 | 2.90 | 2.90 | 2.69 | 2.87 | 1.50 | 2.00 | 2.40 |
| December. | 1.30 | 1.34 | 1.50 | 1.60 | 1.60 | 1.40 | 1.50 | 1.40 | 1.12 | 1.66 | 1.21 | 1.07 | 1.84 | 3.00 | 2.90 | 2.80 | 2.75 | 2.35 | 1.50 | 2.00 | 2.40 |
| *Average..* | *1.56* | *1.33* | *1.48* | *1.51* | *1.60* | *1.49* | *1.33* | *1.44* | *1.26* | *1.29* | *1.55* | *1.15* | *1.31* | *2.67* | *3.63* | *2.89* | *2.50* | *3.22* | *1.87* | *1.71* | *2.36* |

### *Tank Plates at Pittsburgh, Cents per Pound*

| | 1903 | 1904 | 1905 | 1906 | 1907 | 1908 | 1909 | 1910 | 1911 | 1912 | 1913 | 1914 | 1915 | 1916 | 1917 | 1918 | 1919 | 1920 | 1921 | 1922 | 1923 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| January .. | 1.75 | 1.60 | 1.50 | 1.60 | 1.70 | 1.70 | 1.60 | 1.55 | 1.40 | 1.15 | 1.75 | 1.20 | 1.10 | 2.25 | 4.45 | 3.25 | 3.00 | 2.72 | 2.65 | 1.48 | 2.06 |
| February . | 1.60 | 1.60 | 1.50 | 1.60 | 1.70 | 1.70 | 1.52 | 1.55 | 1.40 | 1.11 | 1.71 | 1.20 | 1.10 | 2.56 | 4.88 | 3.25 | 3.00 | 3.50 | 2.33 | 1.39 | 2.23 |
| March.... | 1.60 | 1.60 | 1.60 | 1.60 | 1.70 | 1.70 | 1.30 | 1.55 | 1.40 | 1.12 | 1.70 | 1.18 | 1.10 | 3.10 | 5.25 | 3.25 | 2.91 | 3.63 | 2.04 | 1.39 | 2.39 |
| April .. | 1.60 | 1.60 | 1.60 | 1.60 | 1.70 | 1.70 | 1.27 | 1.55 | 1.40 | 1.21 | 1.68 | 1.15 | 1.15 | 3.56 | 5.88 | 3.25 | 2.65 | 3.75 | 2.10 | 1.48 | 2.50 |
| May ..... | 1.60 | 1.60 | 1.60 | 1.60 | 1.70 | 1.70 | 1.29 | 1.51 | 1.39 | 1.25 | 1.60 | 1.12 | 1.15 | 3.75 | 6.60 | 3.25 | 2.65 | 3.75 | 2.20 | 1.56 | 2.50 |
| June ..... | 1.60 | 1.60 | 1.60 | 1.60 | 1.70 | 1.62 | 1.25 | 1.48 | 1.35 | 1.25 | 1.45 | 1.10 | 1.16 | 3.63 | 8.00 | 3.25 | 2.65 | 3.55 | 1.95 | 1.63 | 2.50 |
| July...... | 1.60 | 1.60 | 1.60 | 1.60 | 1.70 | 1.60 | 1.33 | 1.41 | 1.35 | 1.30 | 1.45 | 1.10 | 1.22 | 3.44 | 9.00 | 3.25 | 2.65 | 3.38 | 1.85 | 1.70 | 2.50 |
| August .. | 1.60 | 1.60 | 1.60 | 1.60 | 1.70 | 1.60 | 1.40 | 1.40 | 1.34 | 1.35 | 1.44 | 1.18 | 1.26 | 3.70 | 8.80 | 3.25 | 2.65 | 3.25 | 1.78 | 1.88 | 2.50 |
| September | 1.60 | 1.44 | 1.60 | 1.60 | 1.70 | 1.60 | 1.46 | 1.40 | 1.29 | 1.47 | 1.40 | 1.20 | 1.34 | 4.00 | 9.00 | 3.25 | 2.53 | 3.25 | 1.64 | 2.13 | 2.50 |
| October... | 1.60 | 1.40 | 1.60 | 1.60 | 1.70 | 1.60 | 1.50 | 1.40 | 1.17 | 1.53 | 1.36 | 1.14 | 1.44 | 4.00 | 3.25 | 3.25 | 2.61 | 3.00 | 1.60 | 2.11 | 2.50 |
| November. | 1.60 | 1.40 | 1.60 | 1.62 | 1.70 | 1.60 | 1.54 | 1.40 | 1.13 | 1.59 | 1.26 | 1.08 | 1.65 | 4.15 | 3.25 | 3.25 | 2.65 | 2.81 | 1.54 | 1.99 | 2.50 |
| December. | 1.60 | 1.45 | 1.60 | 1.70 | 1.70 | 1.60 | 1.55 | 1.40 | 1.15 | 1.60 | 1.20 | 1.05 | 2.04 | 4.25 | 3.25 | 3.13 | 2.65 | 2.65 | 1.50 | 1.95 | 2.50 |
| *Average..* | *1.61* | *1.54* | *1.58* | *1.61* | *1.70* | *1.64* | *1.42* | *1.47* | *1.31* | *1.33* | *1.50* | *1.14* | *1.31* | *3.53* | *5.88* | *3.24* | *2.72* | *3.28* | *1.93* | *1.72* | *2.43* |

### *Beams at Pittsburgh, Cents per Pound*

| | 1903 | 1904 | 1905 | 1906 | 1907 | 1908 | 1909 | 1910 | 1911 | 1912 | 1913 | 1914 | 1915 | 1916 | 1917 | 1918 | 1919 | 1920 | 1921 | 1922 | 1923 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| January... | 1.80 | 1.60 | 1.50 | 1.70 | 1.70 | 1.70 | 1.60 | 1.55 | 1.40 | 1.15 | 1.75 | 1.20 | 1.10 | 1.90 | 3.25 | 3.00 | 2.80 | 2.47 | 2.45 | 1.50 | 2.06 |
| February.. | 1.60 | 1.60 | 1.50 | 1.70 | 1.70 | 1.70 | 1.52 | 1.51 | 1.40 | 1.11 | 1.71 | 1.20 | 1.10 | 2.06 | 3.25 | 3.00 | 2.80 | 2.70 | 2.26 | 1.39 | 2.20 |
| March.... | 1.60 | 1.60 | 1.60 | 1.70 | 1.70 | 1.70 | 1.30 | 1.50 | 1.40 | 1.15 | 1.70 | 1.19 | 1.10 | 2.40 | 3.54 | 3.00 | 2.71 | 3.13 | 2.08 | 1.39 | 2.39 |
| April...... | 1.60 | 1.60 | 1.60 | 1.70 | 1.70 | 1.70 | 1.27 | 1.50 | 1.40 | 1.21 | 1.68 | 1.15 | 1.20 | 2.55 | 3.88 | 3.00 | 2.45 | 3.25 | 2.10 | 1.50 | 2.50 |
| May...... | 1.60 | 1.60 | 1.60 | 1.70 | 1.70 | 1.70 | 1.27 | 1.50 | 1.39 | 1.25 | 1.50 | 1.14 | 1.20 | 2.60 | 4.00 | 3.00 | 2.45 | 3.10 | 2.20 | 1.56 | 2.50 |
| June...... | 1.60 | 1.60 | 1.60 | 1.70 | 1.70 | 1.62 | 1.25 | 1.48 | 1.35 | 1.25 | 1.45 | 1.11 | 1.20 | 2.53 | 4.31 | 3.00 | 2.45 | 3.10 | 2.10 | 1.63 | 2.50 |
| July...... | 1.60 | 1.60 | 1.60 | 1.70 | 1.70 | 1.60 | 1.33 | 1.41 | 1.35 | 1.30 | 1.45 | 1.12 | 1.25 | 2.50 | 4.50 | 3.00 | 2.45 | 3.10 | 1.93 | 1.70 | 2.50 |
| August.... | 1.60 | 1.60 | 1.63 | 1.70 | 1.70 | 1.60 | 1.40 | 1.40 | 1.35 | 1.35 | 1.45 | 1.19 | 1.30 | 2.52 | 4.30 | 3.00 | 2.45 | 3.10 | 1.82 | 1.88 | 2.50 |
| September | 1.60 | 1.44 | 1.70 | 1.70 | 1.70 | 1.60 | 1.46 | 1.40 | 1.34 | 1.42 | 1.41 | 1.20 | 1.35 | 2.64 | 4.00 | 3.00 | 2.45 | 3.10 | 1.64 | 2.00 | 2.50 |
| October... | 1.60 | 1.40 | 1.70 | 1.70 | 1.70 | 1.60 | 1.50 | 1.40 | 1.21 | 1.48 | 1.37 | 1.15 | 1.44 | 2.75 | 3.00 | 3.00 | 2.45 | 3.05 | 1.60 | 2.00 | 2.50 |
| November. | 1.60 | 1.40 | 1.70 | 1.70 | 1.70 | 1.60 | 1.54 | 1.40 | 1.13 | 1.57 | 1.29 | 1.10 | 1.60 | 2.86 | 3.00 | 3.00 | 2.45 | 2.89 | 1.54 | 2.00 | 2.50 |
| December. | 1.60 | 1.44 | 1.70 | 1.70 | 1.70 | 1.60 | 1.55 | 1.40 | 1.15 | 1.60 | 1.25 | 1.07 | 1.78 | 3.25 | 3.00 | 2.90 | 2.45 | 2.45 | 1.50 | 2.00 | 2.50 |
| *Average..* | *1.62* | *1.54* | *1.62* | *1.70* | *1.70* | *1.64* | *1.42* | *1.45* | *1.32* | *1.32* | *1.50* | *1.15* | *1.30* | *2.55* | *3.67* | *2.99* | *2.53* | *2.95* | *1.94* | *1.71* | *2.43* |

# Monthly Averages of Ferroalloy Quotations

*Ferromanganese (80 Per Cent) Prices in Dollars per Gross Ton, at Seaboard*

| | 1911 | 1912 | 1913 | 1914 | 1915 | 1916 | 1917 | 1918 | 1919 | 1920 | 1921 | 1922 | 1923 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| January | $38.04 | $41.00 | $68.00 | $44.40 | $68.00 | $150.00 | $175.00 | $250.00 | $255.00 | $146.00 | $112.50 | $58.35 | $105.00 |
| February | 37.60 | 41.00 | 65.00 | 39.25 | 69.75 | 207.50 | 231.25 | 250.00 | 215.00 | 172.50 | 100.00 | 60.42 | 107.50 |
| March | 37.10 | 41.00 | 65.00 | 38.50 | 100.00 | 349.60 | 290.00 | 250.00 | 175.00 | 216.25 | 96.00 | 62.50 | 113.75 |
| April | 36.75 | 43.00 | 61.00 | 38.00 | 100.00 | 406.25 | 362.50 | 290.00 | 150.00 | 240.00 | 90.00 | 64.37 | 120.00 |
| May | 36.50 | 47.50 | 61.00 | 38.00 | 100.00 | 387.50 | 420.50 | 290.00 | 138.40 | 250.00 | 85.00 | 66.87 | 128.00 |
| June | 36.50 | 49.25 | 61.00 | 38.00 | 100.00 | 270.00 | 443.75 | 290.00 | 121.00 | 225.00 | 80.00 | 67.50 | 128.75 |
| July | 36.50 | 48.88 | 50.00 | 37.20 | 109.00 | 175.00 | 406.25 | 290.00 | 111.00 | 225.00 | 70.60 | 67.50 | *119.50 |
| August | 36.70 | 52.40 | 56.38 | 108.33 | 127.25 | 172.00 | 400.00 | 290.00 | 101.25 | 198.75 | 70.00 | 67.50 | *117.50 |
| September | 37.75 | 59.63 | 56.00 | 90.00 | 117.00 | 169.75 | 387.50 | 285.00 | 98.75 | 170.00 | 65.80 | 75.63 | *111.25 |
| October | 38.50 | 67.80 | 50.10 | 70.40 | 105.00 | 162.25 | 310.00 | 285.00 | 105.00 | 170.00 | 63.00 | 100.00 | *110.00 |
| November | 38.40 | 73.75 | 50.00 | 68.00 | 105.00 | 160.80 | 256.00 | 285.00 | 112.50 | 170.00 | 61.50 | 100.00 | *108.75 |
| December | 39.75 | 75.00 | 47.00 | 72.20 | 106.00 | 169.75 | 243.75 | 275.00 | 122.50 | 135.00 | 60.00 | 100.00 | *108.25 |
| *Average* | *37.51* | *53.35* | *59.29* | *56.86* | *105.83* | *231.70* | *327.21* | *277.50* | *142.12* | *193.21* | *79.53* | *74.22* | *114.85* |

*Price at furnace, where lower than price at seaboard.

*Spiegeleisen (19 to 21 Per Cent), Dollars per Gross Ton at Furnace.*

| | 1914 | 1915 | 1916 | 1917 | 1918 | 1919 | 1920 | 1921 | 1922 | 1923 |
|---|---|---|---|---|---|---|---|---|---|---|
| January | $25.00 | $25.00 | $30.38 | $60.00 | $60.00 | $66.00 | $51.40 | $45.00 | $26.00 | $31.40 |
| February | 25.00 | 25.00 | 36.25 | 68.75 | 61.25 | 60.75 | 58.75 | 40.00 | 28.00 | 35.50 |
| March | 25.00 | 25.00 | 57.00 | 75.00 | 71.25 | 47.00 | 60.00 | 35.00 | 29.40 | 40.00 |
| April | 25.00 | 25.00 | 65.00 | 75.00 | 80.75 | 45.00 | 67.60 | 34.00 | 32.25 | 45.00 |
| May | 25.00 | 25.00 | 65.00 | 81.00 | 84.00 | 37.40 | 75.00 | 32.00 | 35.00 | 52.50 |
| June | 25.00 | 25.00 | 61.00 | 82.50 | 89.00 | 31.25 | 75.00 | 32.00 | 36.00 | 48.50 |
| July | 25.00 | 25.00 | 52.50 | 85.00 | 89.00 | 35.00 | 75.00 | 27.00 | 36.00 | 44.00 |
| August | 25.00 | 25.00 | 45.00 | 85.00 | 89.00 | 35.00 | 80.00 | 26.00 | 37.80 | 46.75 |
| September | 25.00 | 26.60 | 45.00 | 82.50 | 83.75 | 35.00 | 82.00 | 26.00 | 38.25 | 43.75 |
| October | 25.00 | 29.25 | 42.75 | 76.25 | 82.00 | 35.00 | 81.88 | 26.00 | 38.00 | 43.75 |
| November | 25.00 | 29.25 | 45.40 | 66.00 | 80.25 | 37.00 | 75.62 | 26.00 | 37.50 | 41.25 |
| December | 25.00 | 29.25 | 55.00 | 60.00 | 74.38 | 40.00 | 59.10 | 26.00 | 37.50 | 39.00 |
| *Average* | *25.00* | *26.20* | *50.02* | *74.75* | *78.72* | *42.03* | *70.11* | *31.25* | *34.31* | *42.87* |

# Hot-Rolled and Cold-Rolled Strip Steel

*Quoted in cents per pound, at Pittsburgh*

| | Cold-Rolled Strip Steel | | | | | | | Hot-Rolled Strip Steel | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | 1917 | 1918 | 1919 | 1920 | 1921 | 1922 | 1923 | 1917 | 1918 | 1919 | 1920 | 1921 | 1922 | 1923 |
| January | 7.00 | 6.50 | 6.25 | 6.00 | 6.25 | 3.50 | 4.50 | .... | 4.50 | 3.30 | 3.45 | 3.30 | 2.00 | 2.75 |
| February | 7.25 | 6.50 | 6.25 | 7.00 | 6.06 | 3.50 | 4.69 | .... | 4.50 | 3.30 | 4.63 | 3.11 | 1.84 | 2.86 |
| March | 7.63 | 6.50 | 6.10 | 7.00 | 5.83 | 3.50 | 5.00 | .... | 4.50 | 3.30 | 5.00 | 2.93 | 1.81 | 3.18 |
| April | 7.31 | 6.50 | 5.65 | 7.75 | 5.54 | 3.61 | 5.25 | .... | 4.50 | 3.30 | 5.25 | 2.76 | 1.98 | 3.30 |
| May | 7.60 | 6.50 | 5.65 | 8.50 | 4.98 | 3.71 | 5.25 | .... | 4.25 | 3.30 | 5.50 | 2.53 | 2.20 | 3.30 |
| June | 8.63 | 6.50 | 5.65 | 8.50 | 4.88 | 4.00 | 5.19 | .... | 3.50 | 3.05 | 5.50 | 2.50 | 2.40 | 3.23 |
| July | 9.00 | 6.50 | 5.65 | 8.50 | 4.25 | 4.00 | 5.00 | .... | 3.50 | 3.05 | 5.50 | 2.46 | 2.50 | 3.00 |
| August | 9.00 | 6.50 | 5.65 | 8.50 | 3.96 | 4.10 | 5.00 | .... | 3.50 | 3.31 | 5.50 | 2.23 | 2.60 | 3.00 |
| September | 9.00 | 6.50 | 5.65 | 8.50 | 3.78 | 4.25 | 5.00 | .... | 3.50 | 3.30 | 5.50 | 2.00 | 2.75 | 3.00 |
| October | 9.00 | 6.50 | 5.65 | 8.25 | 3.75 | 4.50 | 5.00 | .... | 3.50 | 3.30 | 5.25 | 2.00 | 2.90 | 3.00 |
| November | 6.75 | 6.50 | 5.65 | 8.00 | 3.75 | 4.50 | 4.98 | 4.50 | 3.50 | 3.30 | 4.70 | 2.00 | 2.83 | 3.00 |
| December | 6.50 | 6.35 | 5.93 | 6.63 | 3.75 | 4.50 | 4.91 | 4.50 | 3.50 | 3.30 | 3.65 | 2.00 | 2.75 | 2.88 |
| *Average* | *7.89* | *6.49* | *5.81* | *7.76* | *4.73* | *3.97* | *4.98* | .... | *3.90* | *3.26* | *4.95* | *2.49* | *2.38* | *3.04* |

# Wire Nails at Pittsburgh, Dollars per Keg of 100 Lb.

| | 1903 | 1904 | 1905 | 1906 | 1907 | 1908 | 1909 | 1910 | 1911 | 1912 | 1913 | 1914 | 1915 | 1916 | 1917 | 1918 | 1919 | 1920 | 1921 | 1922 | 1923 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| January | $1.89 | $1.89 | $1.75 | $1.85 | $2.00 | $2.05 | $1.95 | $1.85 | $1.71 | $1.57 | $1.75 | $1.54 | $1.54 | $2.13 | $3.00 | $3.50 | $3.50 | $4.50 | $3.25 | $2.50 | $2.70 |
| February | 1.92 | 1.90 | 1.80 | 1.85 | 2.00 | 2.05 | 1.95 | 1.85 | 1.75 | 1.60 | 1.75 | 1.60 | 1.57 | 2.25 | 3.00 | 3.50 | 3.50 | 4.50 | 3.21 | 2.40 | 2.78 |
| March | 2.00 | 1.91 | 1.80 | 1.85 | 2.00 | 2.05 | 1.95 | 1.85 | 1.79 | 1.60 | 1.76 | 1.60 | 1.60 | 2.40 | 3.20 | 3.50 | 3.44 | 4.00 | 3.02 | 2.40 | 2.83 |
| April | 2.00 | 1.90 | 1.80 | 1.85 | 2.00 | 2.05 | 1.87 | 1.85 | 1.80 | 1.60 | 1.80 | 1.60 | 1.56 | 2.40 | 3.28 | 3.50 | 3.25 | 4.00 | 3.13 | 2.40 | 2.93 |
| May | 2.00 | 1.90 | 1.80 | 1.85 | 2.00 | 2.05 | 1.65 | 1.82 | 1.80 | 1.60 | 1.80 | 1.56 | 1.55 | 2.50 | 3.50 | 3.50 | 3.25 | 4.00 | 3.05 | 2.40 | 3.00 |
| June | 2.00 | 1.90 | 1.74 | 1.85 | 2.00 | 1.97 | 1.70 | 1.80 | 1.75 | 1.60 | 1.80 | 1.50 | 1.55 | 2.50 | 3.75 | 3.50 | 3.25 | 4.00 | 3.00 | 2.40 | 3.00 |
| July | 2.00 | 1.89 | 1.70 | 1.84 | 2.00 | 1.95 | 1.72 | 1.75 | 1.70 | 1.62 | 1.70 | 1.52 | 1.60 | 2.50 | 4.00 | 3.50 | 3.25 | 4.00 | 2.81 | 2.40 | 3.00 |
| August | 2.00 | 1.71 | 1.70 | 1.82 | 2.00 | 1.95 | 1.80 | 1.70 | 1.69 | 1.66 | 1.65 | 1.56 | 1.61 | 2.58 | 4.00 | 3.50 | 3.25 | 4.25 | 2.75 | 2.48 | 3.00 |
| September | 2.00 | 1.60 | 1.74 | 1.86 | 2.05 | 1.95 | 1.80 | 1.70 | 1.65 | 1.70 | 1.65 | 1.60 | 1.69 | 2.60 | 4.00 | 3.50 | 3.25 | 4.25 | 2.86 | 2.63 | 3.00 |
| October | 2.00 | 1.60 | 1.80 | 1.85 | 2.05 | 1.95 | 1.80 | 1.70 | 1.64 | 1.70 | 1.63 | 1.60 | 1.80 | 2.63 | ..... | 3.50 | 3.31 | 4.25 | 2.90 | 2.70 | 3.00 |
| November | 1.97 | 1.62 | 1.80 | 1.88 | 2.05 | 1.95 | 1.80 | 1.70 | 1.55 | 1.70 | 1.59 | 1.50 | 1.87 | 2.85 | 3.50 | 3.50 | 3.50 | 4.05 | 2.84 | 2.70 | 3.00 |
| December | 1.87 | 1.73 | 1.80 | 2.00 | 2.05 | 1.95 | 1.85 | 1.70 | 1.53 | 1.72 | 1.55 | 1.51 | 2.04 | 3.00 | 3.50 | 3.50 | 4.12 | 3.25 | 2.69 | 2.70 | 3.00 |
| *Average* | *1.97* | *1.79* | *1.77* | *1.86* | *2.02* | *1.99* | *1.82* | *1.77* | *1.70* | *1.64* | *1.70* | *1.56* | *1.67* | *2.53* | *3.52* | *3.50* | *3.41* | *4.09* | *2.96* | *2.51* | *2.94* |

*Average Monthly Prices of Pig Iron Delivered Philadelphia or Vicinity in 1923*

| Basic, Delivered Eastern Pa. | | Standard Low Phos. F.o.b. Furnace | | Virginia No. 2X Delivered Phila. | |
|---|---|---|---|---|---|
| Jan. | $27.80 | Jan. | $35.00 | Jan. | $32.97 |
| Feb. | 28.19 | Feb. | 35.00 | Feb. | 33.17 |
| March | 29.56 | March | 35.00 | March | 33.79 |
| April | 30.81 | April | 35.00 | April | 34.67 |
| May | 30.60 | May | 33.20 | May | 35.0 |
| June | 28.14 | June | 30.50 | June | 33.17 |
| July | 26.60 | July | 29.00 | July | 32.27 |
| Aug. | 25.00 | Aug. | 29.00 | Aug. | 31.42 |
| Sept. | 25.00 | Sept. | 28.50 | Sept. | 30.92 |
| Oct. | 24.20 | Oct. | 28.00 | Oct. | 30.17 |
| Nov. | 22.87 | Nov. | 27.87 | Nov. | 30.17 |
| Dec. | 23.12 | Dec. | 27.50 | Dec. | 30.17 |

*Cotton Tie Prices for Twenty-One Years*
(Per Bundle of 45-Lb.)

| | | | | | |
|---|---|---|---|---|---|
| 1903 | $0.85 | 1910 | $0.75 | 1917 | $2.10 |
| 1904 | 0.75 | 1911 | 0.75 | 1918 | 2.10 |
| 1905 | 0.85 | 1912 | 0.70 | 1919 | 1.70 |
| 1906 | 0.85 | 1913 | 0.80 | 1920 | 2.00 |
| 1907 | 0.95 | 1914 | 0.65 | 1921 | 1.30 |
| 1908 | 0.85 | 1915 | 0.85 | 1922 | 1.10 |
| 1909 | 0.70 | 1916 | 1.35 | 1923 | 1.60 |

*Foundry Pig Iron and Scrap Prices, Cincinnati, 1923*

| | Southern Foundry No. 2 | Southern Ohio No. 2 | No. 1 R.R. Wrought (Net Ton) | No. 1 Mach. Cast (Net Ton) |
|---|---|---|---|---|
| January | $27.45 | $29.77 | $15.25 | $20.38 |
| February | 28.68 | 30.27 | 16.37 | 21.75 |
| March | 30.80 | 32.67 | 18.65 | 23.65 |
| April | 31.05 | 33.14 | 18.75 | 24.75 |
| May | 30.75 | 32.22 | 16.35 | 24.05 |
| June | 29.30 | 30.52 | 13.75 | 22.13 |
| July | 28.85 | 28.71 | 12.75 | 20.25 |
| August | 27.68 | 28.07 | 12.95 | 19.05 |
| September | 26.55 | 27.02 | 13.63 | 19.38 |
| October | 24.85 | 26.92 | 12.00 | 18.00 |
| November | 23.68 | 24.77 | 11.35 | 16.85 |
| December | 25.05 | 24.77 | 12.50 | 18.00 |

*Average Monthly Pig Iron Prices F.o.b. Valley Furnace*
(Per Gross Ton, 1923)

| | Bessemer | Basic | No. 2 Foundry | Gray Forge | Malleable |
|---|---|---|---|---|---|
| January | $27.50 | $25.80 | $27.00 | $26.50 | $27.00 |
| February | 28.0625 | 26.25 | 27.50 | 27.00 | 27.625 |
| March | 30.25 | 30.125 | 30.50 | 30.00 | 30.50 |
| April | 31.00 | 31.00 | 31.00 | 30.50 | 31.00 |
| May | 30.10 | 29.00 | 30.20 | 29.70 | 30.20 |
| June | 28.50 | 27.375 | 27.625 | 26.625 | 28.125 |
| July | 26.70 | 25.10 | 25.50 | 25.00 | 25.40 |
| August | 26.50 | 24.75 | 24.875 | 24.00 | 24.50 |
| September | 26.50 | 24.875 | 24.75 | 24.00 | 24.50 |
| October | 25.20 | 23.50 | 23.60 | 23.30 | 23.30 |
| November | 23.25 | 20.875 | 21.875 | 21.375 | 20.875 |
| December | 22.875 | 21.00 | 22.25 | 21.50 | 20.00 |

# Wrought Iron and Steel Pipe Prices

Computed from discounts as per list, for carload lots; price for base size pipe, ¾ to 3-in.

### *Wrought Iron Pipe, per Gross Ton*

| | 1903 | 1904 | 1905 | 1906 | 1907 | 1908 | 1909 | 1910 | 1911 | 1912 | 1913 | 1914 | 1915 | 1916 | 1917 | 1918 | 1919 | 1920 | 1921 | 1922 | 1923 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| January | $53.76 | $49.28 | $53.67 | $49.28 | $58.53 | $67.20 | $62.72 | $53.76 | $56.00 | $56.00 | $60.48 | $62.72 | $62.72 | $72.98 | $103.04 | $150.08 | $143.36 | $140.94 | $166.68 | $100.96 | $123.38 |
| February | 53.76 | 49.28 | 54.88 | 49.28 | 67.20 | 67.20 | 57.92 | 53.76 | 56.00 | 56.00 | 60.48 | 62.72 | 62.72 | 77.40 | 105.44 | 150.08 | 143.36 | 146.72 | 166.68 | 100.96 | 127.83 |
| March | 53.76 | 52.95 | 56.00 | 49.28 | 67.20 | 67.20 | 49.28 | 53.76 | 56.00 | 56.00 | 60.48 | 62.72 | 62.72 | 82.09 | 111.42 | 150.08 | 140.58 | 146.72 | 157.92 | 100.96 | 127.83 |
| April | 53.76 | 53.76 | 56.41 | 49.28 | 67.20 | 67.20 | 49.28 | 53.76 | 56.00 | 56.00 | 60.48 | 62.72 | 62.72 | 86.61 | 125.01 | 150.08 | 135.52 | 146.72 | 152.54 | 100.96 | 127.83 |
| May | 53.76 | 53.76 | 57.12 | 49.28 | 67.20 | 67.20 | 49.28 | 53.76 | 56.00 | 56.00 | 60.48 | 62.72 | 64.96 | 89.60 | 138.88 | 150.08 | 135.52 | 146.72 | 144.48 | 100.96 | 127.83 |
| June | 53.76 | 51.52 | 57.12 | 49.28 | 70.34 | 64.06 | 49.28 | 53.76 | 56.00 | 56.00 | 62.65 | 62.72 | 64.96 | 89.60 | 138.88 | 150.08 | 135.52 | 146.72 | 144.48 | 100.96 | 127.83 |
| July | 53.76 | 51.12 | 57.12 | 49.28 | 71.68 | 62.72 | 49.28 | 53.76 | 56.00 | 56.00 | 62.72 | 62.72 | 64.96 | 89.60 | 149.72 | 150.08 | 135.52 | 146.72 | 137.01 | 100.96 | 127.83 |
| August | 53.76 | 51.12 | 57.12 | 49.28 | 71.68 | 62.72 | 53.33 | 53.76 | 56.00 | 56.00 | 62.72 | 62.72 | 64.96 | 89.60 | 150.08 | 150.08 | 135.52 | 146.72 | 135.52 | 102.81 | 127.83 |
| September | 53.76 | 51.12 | 57.12 | 49.28 | 71.68 | 62.72 | 53.76 | 53.76 | 56.00 | 58.17 | 62.72 | 62.72 | 64.96 | 91.39 | 150.08 | 150.08 | 135.52 | 146.72 | 124.32 | 115.32 | 127.83 |
| October | 53.76 | 51.12 | 49.54 | 52.17 | 70.38 | 62.72 | 53.76 | 56.00 | 56.00 | 58.24 | 62.72 | 62.72 | 64.96 | 91.84 | 150.08 | 150.08 | 135.52 | 146.72 | 124.32 | 120.41 | 127.83 |
| November | 53.76 | 51.12 | 49.28 | 53.76 | 67.20 | 62.72 | 53.76 | 56.00 | 56.00 | 60.48 | 62.72 | 62.72 | 67.20 | 93.03 | 150.08 | 150.08 | 135.52 | 146.72 | 124.32 | 120.41 | 127.83 |
| December | 53.62 | 51.12 | 49.28 | 55.06 | 67.20 | 62.72 | 53.76 | 56.00 | 56.00 | 60.48 | 62.72 | 62.72 | 67.20 | 98.42 | 150.08 | 150.08 | 135.52 | 157.78 | 124.32 | 120.41 | 127.83 |
| *Average* | *53.75* | *51.44* | *54.56* | *50.38* | *68.46* | *64.70* | *52.95* | *54.32* | *56.00* | *57.11* | *61.68* | *62.72* | *64.59* | *87.68* | *136.90* | *150.08* | *137.25* | *147.16* | *141.88* | *107.17* | *127.46* |

### *Steel Pipe, per Gross Ton*

| | 1903 | 1904 | 1905 | 1906 | 1907 | 1908 | 1909 | 1910 | 1911 | 1912 | 1913 | 1914 | 1915 | 1916 | 1917 | 1918 | 1919 | 1920 | 1921 | 1922 | 1923 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| January | $56.00 | $51.52 | $51.70 | $47.04 | $56.58 | $62.72 | $58.24 | $49.28 | $44.80 | $40.32 | $44.80 | $44.80 | $42.56 | $52.17 | $80.64 | $109.76 | $103.04 | $95.20 | $95.20 | $51.87 | $61.13 |
| February | 56.00 | 53.76 | 53.76 | 47.04 | 58.24 | 62.72 | 54.24 | 49.28 | 44.80 | 40.32 | 44.80 | 45.88 | 44.16 | 55.00 | 83.04 | 109.76 | 103.04 | 95.20 | 95.20 | 51.87 | 66.50 |
| March | 56.00 | 56.00 | 54.88 | 47.04 | 60.84 | 62.72 | 47.04 | 49.28 | 44.80 | 40.32 | 44.80 | 45.92 | 44.80 | 59.69 | 89.02 | 109.76 | 100.51 | 95.20 | 95.20 | 51.87 | 66.50 |
| April | 56.00 | 56.00 | 55.29 | 47.04 | 62.72 | 62.72 | 47.04 | 49.28 | 44.80 | 40.32 | 45.51 | 45.51 | 44.80 | 64.21 | 100.43 | 109.76 | 95.20 | 95.20 | 88.48 | 51.87 | 67.70 |
| May | 56.00 | 56.00 | 56.00 | 47.04 | 62.72 | 62.72 | 47.04 | 49.28 | 44.80 | 40.32 | 46.10 | 44.80 | 47.04 | 67.20 | 100.80 | 109.76 | 95.20 | 95.20 | 84.00 | 51.87 | 70.30 |
| June | 56.00 | 53.76 | 56.00 | 47.04 | 62.72 | 59.58 | 47.04 | 49.28 | 44.80 | 42.56 | 47.04 | 44.80 | 47.04 | 67.20 | 100.80 | 109.76 | 95.20 | 95.20 | 84.00 | 51.87 | 70.30 |
| July | 56.00 | 48.16 | 56.00 | 47.04 | 62.72 | 58.24 | 47.04 | 49.28 | 44.80 | 43.14 | 47.04 | 44.80 | 47.04 | 67.20 | 100.80 | 109.76 | 95.20 | 95.20 | 80.39 | 51.87 | 70.30 |
| August | 56.00 | 48.16 | 56.00 | 47.04 | 62.72 | 58.24 | 47.04 | 49.28 | 44.80 | 44.80 | 45.31 | 44.80 | 47.04 | 67.20 | 100.80 | 109.76 | 95.20 | 95.20 | 79.52 | 52.98 | 70.30 |
| September | 56.00 | 47.11 | 56.00 | 47.04 | 62.72 | 58.24 | 47.04 | 49.28 | 44.80 | 46.37 | 44.80 | 44.80 | 47.04 | 68.99 | 100.80 | 109.76 | 95.20 | 95.20 | 75.04 | 57.43 | 70.30 |
| October | 56.00 | 47.98 | 47.33 | 49.93 | 62.72 | 58.24 | 49.28 | 44.80 | 42.63 | 47.04 | 44.80 | 44.80 | 47.04 | 69.44 | 100.80 | 109.76 | 95.20 | 95.20 | 70.56 | 58.91 | 70.30 |
| November | 56.00 | 51.52 | 47.04 | 51.52 | 62.72 | 58.24 | 49.28 | 44.80 | 42.56 | 47.04 | 44.80 | 42.63 | 49.28 | 70.63 | 108.27 | 109.76 | 95.20 | 95.20 | 70.56 | 61.13 | 70.30 |
| December | 56.00 | 51.52 | 47.04 | 54.41 | 62.72 | 58.24 | 49.28 | 44.80 | 40.32 | 47.04 | 44.80 | 42.56 | 49.28 | 76.45 | 109.76 | 105.64 | 95.20 | 95.20 | 67.49 | 61.13 | 70.30 |
| *Average* | *56.00* | *51.79* | *53.09* | *48.33* | *61.68* | *60.22* | *49.13* | *48.16* | *44.06* | *43.30* | *45.38* | *44.68* | *46.43* | *65.45* | *98.00* | *109.42* | *96.95* | *95.20* | *82.14* | *54.56* | *68.69* |

# Cast Iron Pipe Prices, 1902 to 1922

### *At New York, 6-Inch, per Net Ton*

| | 1903 | 1904 | 1905 | 1906 | 1907 | 1908 | 1909 | 1910 | 1911 | 1912 | 1913 | 1914 | 1915 | 1916 | 1917 | 1918 | 1919 | 1920 | 1921 | 1922 | 1923 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| January | $29.25 | $24.50 | $28.00 | $29.75 | $34.25 | $27.00 | $24.50 | $25.50 | $22.00 | $22.00 | $25.00 | $22.00 | $20.00 | $29.00 | $41.50 | $55.35 | $65.70 | $66.30 | $63.30 | $47.30 | $54.90 |
| February | 29.25 | 24.25 | 28.50 | 29.50 | 34.25 | 26.75 | 24.25 | 25.50 | 21.50 | 22.00 | 24.75 | 22.00 | 20.00 | 29.33 | 41.50 | 55.35 | 62.70 | 70.30 | 63.30 | 47.30 | 56.50 |
| March | 30.75 | 24.25 | 26.75 | 30.50 | 34.00 | 26.25 | 25.25 | 25.50 | 21.00 | 22.00 | 23.87 | 22.00 | 20.00 | 29.75 | 43.10 | 55.35 | 62.70 | 71.30 | 63.30 | 47.68 | 57.75 |
| April | 31.00 | 24.25 | 27.00 | 29.75 | 33.50 | 26.25 | 25.00 | 25.50 | 21.00 | 21.25 | 23.50 | 22.00 | 21.60 | 30.50 | 50.88 | 55.35 | 57.70 | 73.90 | 63.30 | 48.80 | 58.50 |
| May | 30.75 | 24.00 | 27.25 | 31.00 | 34.25 | 26.25 | 25.25 | 25.50 | 21.00 | 21.00 | 23.00 | 20.88 | 22.00 | 30.50 | 55.50 | 56.00 | 54.45 | 76.30 | 62.05 | 49.60 | 58.50 |
| June | 30.75 | 23.50 | 27.25 | 32.50 | 33.50 | 25.75 | 26.00 | 25.25 | 21.00 | 21.00 | 23.00 | 20.50 | 22.25 | 30.50 | 60.75 | 61.44 | 52.03 | 76.30 | 54.30 | 50.80 | 61.35 |
| July | 30.75 | 23.50 | 27.25 | 30.25 | 34.00 | 25.75 | 26.25 | 24.00 | 21.00 | 22.10 | 23.00 | 20.50 | 22.50 | 30.50 | 65.50 | 61.75 | 50.46 | 76.30 | 52.30 | 53.50 | 62.30 |
| August | 29.50 | 23.50 | 27.75 | 30.50 | 32.50 | 25.25 | 26.00 | 23.50 | 21.00 | 22.00 | 23.00 | 20.50 | 23.25 | 30.50 | 65.50 | 61.75 | 52.33 | 76.53 | 46.05 | 54.10 | 62.62 |
| September | 29.00 | 23.00 | 27.25 | 31.00 | 33.00 | 25.75 | 25.75 | 23.50 | 21.00 | 23.12 | 23.00 | 20.40 | 24.37 | 30.83 | 65.50 | 61.75 | 54.30 | 77.22 | 46.30 | 54.50 | 63.60 |
| October | 26.00 | 23.25 | 28.25 | 33.00 | 33.50 | 25.75 | 25.50 | 23.00 | 21.00 | 24.50 | 23.00 | 20.00 | 25.25 | 31.50 | 61.00 | 67.70 | 55.30 | 77.22 | 47.30 | 54.50 | 63.60 |
| November | 24.50 | 25.00 | 29.00 | 33.25 | 28.50 | 25.00 | 25.87 | 22.12 | 21.40 | 24.12 | 23.00 | 20.00 | 26.50 | 35.50 | 56.50 | 67.70 | 58.30 | 77.22 | 47.30 | 54.50 | 63.60* |
| December | 24.25 | 27.00 | 29.25 | 35.50 | 28.00 | 25.50 | 25.70 | 22.00 | 22.00 | 24.62 | 22.33 | 20.00 | 27.60 | 41.00 | 56.50 | 67.70 | 61.30 | 68.87 | 47.30 | 54.75 | 63.60* |
| *Average* | *28.81* | *24.17* | *27.79* | *31.38* | *32.77* | *25.94* | *25.44* | *24.24* | *21.24* | *22.48* | *23.37* | *20.90* | *22.94* | *31.62* | *55.31* | *60.65* | *57.27* | *73.98* | *54.68* | *51.44* | *60.57* |

*Concession of $2 to $3 per ton from this price to consumers willing to accept winter delivery.

# Connellsville Coke Prices for Twenty-one Years

### *Average Prices of Prompt Connellsville Furnace Coke, per Net Ton at Oven*

| | 1903 | 1904 | 1905 | 1906 | 1907 | 1908 | 1909 | 1910 | 1911 | 1912 | 1913 | 1914 | 1915 | 1916 | 1917 | 1918 | 1919 | 1920 | 1921 | 1922 | 1923 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| January | $5.00 | $1.60 | $2.46 | $2.62 | $3.53 | $1.92 | $1.59 | $2.55 | $1.40 | $1.82 | $3.88 | $1.85 | $1.50 | $2.94 | $9.50 | $6.00 | $5.65 | $6.00 | $5.06 | $2.75 | $8.05 |
| February | 5.00 | 1.52 | 2.56 | 2.14 | 3.50 | 1.86 | 1.59 | 2.12 | 1.45 | 1.78 | 2.52 | 1.85 | 1.50 | 3.38 | 9.62 | 6.00 | 4.44 | 6.00 | 4.50 | 3.04 | 7.13 |
| March | 5.00 | 1.65 | 2.43 | 2.24 | 3.02 | 1.72 | 1.60 | 2.00 | 1.55 | 2.12 | 2.40 | 1.90 | 1.50 | 3.47 | 9.60 | 6.00 | 4.06 | 6.00 | 4.35 | 3.25 | 7.25 |
| April | 4.20 | 1.60 | 2.07 | 2.45 | 2.72 | 1.57 | 1.60 | 1.77 | 1.59 | 2.39 | 2.15 | 1.86 | 1.50 | 2.41 | 7.38 | 6.00 | 3.65 | 9.00 | 3.50 | 4.48 | 6.31 |
| May | 3.50 | 1.50 | 1.87 | 2.46 | 2.16 | 1.50 | 1.57 | 1.66 | 1.50 | 2.28 | 2.13 | 1.77 | 1.50 | 2.30 | 7.80 | 6.00 | 3.69 | 12.00 | 3.25 | 6.00 | 5.15 |
| June | 3.00 | 1.45 | 1.82 | 2.32 | 1.89 | 1.55 | 1.52 | 1.65 | 1.42 | 2.02 | 2.11 | 1.75 | 1.56 | 2.49 | 11.25 | 6.00 | 4.00 | 15.00 | 3.00 | 6.75 | 4.75 |
| July | 2.50 | 1.45 | 1.81 | 2.51 | 2.40 | 1.57 | 1.58 | 1.59 | 1.44 | 2.21 | 2.45 | 1.75 | 1.64 | 2.75 | 12.75 | 6.00 | 4.07 | 17.20 | 2.81 | 10.75 | 4.55 |
| August | 2.25 | 1.45 | 1.80 | 2.76 | 2.62 | 1.50 | 1.66 | 1.57 | 1.46 | 2.21 | 2.50 | 1.70 | 1.50 | 2.80 | 13.60 | 6.00 | 4.31 | 17.75 | 2.75 | 12.80 | 4.55 |
| September | 2.20 | 1.45 | 2.10 | 2.85 | 2.82 | 1.50 | 2.39 | 1.60 | 1.50 | 2.37 | 2.29 | 1.65 | 1.61 | 2.94 | 11.12 | 6.00 | 4.56 | 16.70 | 3.15 | 11.13 | 4.50 |
| October | 1.90 | 1.47 | 2.61 | 2.84 | 2.85 | 1.53 | 2.76 | 1.50 | 1.50 | 3.41 | 2.98 | 1.60 | 2.03 | 4.88 | 6.00 | 6.00 | 4.52 | 15.12 | 3.28 | 9.60 | 3.85 |
| November | 1.75 | 2.04 | 2.95 | 3.13 | 2.41 | 1.72 | 2.74 | 1.50 | 1.52 | 3.94 | 1.82 | 1.52 | 2.28 | 6.90 | 6.00 | 6.00 | 5.87 | 8.26 | 3.03 | 7.19 | 3.81 |
| December | 1.62 | 2.12 | 2.79 | 3.52 | 2.06 | 1.82 | 2.67 | 1.44 | 1.60 | 4.00 | 1.76 | 1.50 | 2.64 | 8.38 | 6.00 | 6.00 | 6.12 | 6.20 | 2.75 | 7.00 | 4.00 |
| *Average* | *3.16* | *1.61* | *2.27* | *2.65* | *2.67* | *1.65* | *1.94* | *1.75* | *1.49* | *2.55* | *2.42* | *1.73* | *1.73* | *3.80* | *9.22* | *6.00* | *4.58* | *11.32* | *3.45* | *7.06* | *5.33* |

### *Average Prices of Prompt Connellsville Foundry Coke, per Net Ton at Oven*

| | 1903 | 1904 | 1905 | 1906 | 1907 | 1908 | 1909 | 1910 | 1911 | 1912 | 1913 | 1914 | 1915 | 1916 | 1917 | 1918 | 1919 | 1920 | 1921 | 1922 | 1923 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| January | $6.50 | $2.18 | $2.38 | $3.42 | $4.25 | $2.45 | $2.00 | $2.90 | $1.90 | $1.97 | $4.40 | $2.50 | $2.00 | $3.50 | $9.75 | $7.00 | $6.25 | $7.00 | $6.38 | $3.75 | $8.70 |
| February | 6.50 | 2.10 | 2.68 | 2.65 | 4.00 | 2.39 | 1.95 | 2.70 | 2.10 | 2.09 | 3.25 | 2.50 | 2.00 | 3.50 | 11.00 | 7.00 | 5.00 | 7.00 | 5.63 | 4.00 | 8.25 |
| March | 6.50 | 2.25 | 2.75 | 2.78 | 3.65 | 2.25 | 1.95 | 2.60 | 2.05 | 2.56 | 3.00 | 2.45 | 2.00 | 3.75 | 11.60 | 7.00 | 4.94 | 7.00 | 5.45 | 4.25 | 8.38 |
| April | 5.50 | 2.15 | 2.70 | 2.95 | 3.31 | 2.22 | 1.86 | 2.45 | 2.00 | 2.69 | 3.00 | 2.40 | 2.00 | 3.56 | 9.13 | 7.00 | 4.30 | 10.20 | 4.75 | 5.06 | 7.56 |
| May | 4.50 | 2.00 | 2.55 | 2.81 | 3.00 | 2.03 | 1.85 | 2.20 | 1.81 | 2.58 | 2.85 | 2.40 | 2.00 | 3.25 | 8.90 | 7.00 | 4.31 | 13.00 | 4.50 | 6.30 | 6.15 |
| June | 3.50 | 1.90 | 2.40 | 2.65 | 3.00 | 2.00 | 1.80 | 2.17 | 1.76 | 2.40 | 2.80 | 2.32 | 2.00 | 3.25 | 11.72 | 7.00 | 4.56 | 15.75 | 4.45 | 7.25 | 5.56 |
| July | 3.25 | 1.80 | 2.35 | 2.79 | 3.00 | 2.00 | 2.00 | 2.15 | 1.82 | 2.40 | 2.70 | 2.22 | 2.05 | 3.25 | 13.25 | 7.00 | 5.00 | 17.80 | 4.06 | 11.00 | 5.35 |
| August | 3.00 | 1.75 | 2.25 | 3.00 | 3.08 | 1.92 | 1.95 | 2.15 | 1.85 | 2.40 | 2.90 | 2.25 | 2.00 | 3.30 | 13.20 | 7.00 | 5.25 | 18.88 | 3.75 | 13.90 | 5.38 |
| September | 2.87 | 1.85 | 2.50 | 3.19 | 3.20 | 1.90 | 2.55 | 2.12 | 1.85 | 2.54 | 2.90 | 2.10 | 2.07 | 3.31 | 11.75 | 7.00 | 5.80 | 17.70 | 4.15 | 12.50 | 5.50 |
| October | 2.87 | 2.00 | 3.00 | 3.31 | 3.25 | 2.10 | 2.90 | 2.10 | 1.81 | 3.65 | 2.81 | 2.00 | 2.35 | 3.88 | 6.00 | 7.00 | 6.25 | 16.38 | 4.38 | 11.70 | 4.80 |
| November | 2.50 | 2.25 | 3.50 | 4.00 | 2.75 | 2.20 | 3.25 | 2.05 | 1.85 | 4.25 | 2.60 | 1.92 | 2.88 | 7.10 | 7.00 | 7.00 | 7.00 | 9.50 | 4.19 | 8.38 | 4.81 |
| December | 2.25 | 2.35 | 3.50 | 4.12 | 2.50 | 2.25 | 3.20 | 1.97 | 1.90 | 4.50 | 2.50 | 1.90 | 2.95 | 8.63 | 7.00 | 7.00 | 7.00 | 7.00 | 3.81 | 7.88 | 4.81 |
| *Average* | *4.15* | *2.05* | *2.71* | *3.14* | *3.25* | *2.14* | *2.27* | *2.30* | *1.89* | *2.84* | *2.98* | *2.25* | *2.19* | *4.19* | *10.03* | *7.00* | *5.47* | *12.27* | *4.63* | *8.00* | *6.27* |

# Finished Iron and Steel at Chicago

(Cents Per Lb.)

| 1923 | Common Bar Iron | Soft Steel Bars | Structural Steel |
|---|---|---|---|
| January | 2.35 | 2.08 | 2.18 |
| February | 2.46 | 2.21 | 2.31 |
| March | 2.53 | 2.45 | 2.52 |
| April | 2.60 | 2.84 | 2.84 |
| May | 2.60 | 2.74 | 2.84 |
| June | 2.55 | 2.60 | 2.70 |
| July | 2.50 | 2.60 | 2.70 |
| August | 2.40 | 2.60 | 2.70 |
| September | 2.39 | 2.50 | 2.60 |
| October | 2.38 | 2.50 | 2.60 |
| November | 2.40 | 2.50 | 2.60 |
| December | 2.40 | 2.50 | 2.60 |

*Yearly Averages*

| | Common Bar Iron | Soft Steel Bars | Structural Steel |
|---|---|---|---|
| 1923 | 2.47 | 2.51 | 2.59 |
| 1922 | 1.95 | 1.83 | 1.86 |
| 1921 | 2.12 | 2.16 | 2.225 |
| 1920 | 3.72 | 3.34 | 3.22 |
| 1919 | 2.68 | 2.74 | 2.79 |
| 1918 | 3.50 | 3.08 | 3.18 |
| 1917 | 3.77 | 3.772 | 4.275 |
| 1916 | 2.31 | 2.94 | 2.83 |
| 1915 | 1.24 | 1.48 | 1.48 |
| 1914 | 1.06 | 1.32 | 1.34 |
| 1913 | 1.43 | 1.55 | 1.60 |
| 1912 | 1.32 | 1.42 | 1.46 |

*Yearly Averages*

| | Common Bar Iron | Soft Steel Bars | Structural Steel |
|---|---|---|---|
| 1911 | 1.22 | 1.47 | 1.50 |
| 1910 | 1.45 | 1.62 | 1.66 |
| 1909 | 1.43 | 1.50 | 1.59 |
| 1908 | 1.56 | 1.66 | 1.82 |
| 1907 | 1.78 | 1.77 | 1.87 |
| 1906 | 1.71 | 1.68 | 1.86 |
| 1905 | 1.65 | 1.65 | 1.78 |
| 1904 | 1.41 | 1.50 | 1.71 |
| 1903 | 1.65 | 1.72 | 1.75 |
| 1902 | 1.71 | 1.73 | 1.75 |
| 1901 | 1.58 | 1.58 | 1.70 |
| 1900 | 1.75 | 1.75 | 2.00 |

# Scrap Prices at Chicago, 1905 to 1923

## *Heavy Melting Steel Scrap, per Gross Ton*

| | 1905 | 1906 | 1907 | 1908 | 1909 | 1910 | 1911 | 1912 | 1913 | 1914 | 1915 | 1916 | 1917 | 1918 | 1919 | 1920 | 1921 | 1922 | 1923 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| January | $14.88 | $14.95 | $16.80 | $11.05 | $13.94 | $16.00 | $11.75 | $10.75 | $12.60 | $ 9.35 | $9.19 | $15.50 | $21.12 | $30.00 | $17.40 | $24.50 | $15.13 | $11.45 | $19.15 |
| February | 14.13 | 13.63 | 15.75 | 12.50 | 13.56 | 15.50 | 12.06 | 10.75 | 12.13 | 10.50 | 9.56 | 14.75 | 21.50 | 30.25 | 15.06 | 25.00 | 15.13 | 11.38 | 20.33 |
| March | 14.45 | 13.00 | 16.00 | 11.44 | 12.13 | 15.00 | 12.15 | 10.94 | 12.08 | 9.81 | 9.63 | 16.50 | 23.70 | 29.87 | 15.63 | 24.25 | 12.50 | 12.38 | 23.50 |
| April | 14.38 | 13.50 | 15.75 | 11.05 | 12.35 | 14.44 | 11.75 | 11.56 | 12.50 | 9.80 | 9.15 | 16.50 | 27.00 | 28.75 | 16.41 | 23.75 | 11.00 | 13.75 | 22.50 |
| May | 12.55 | 13.70 | 15.60 | 10.62 | 13.44 | 13.56 | 10.50 | 12.05 | 11.25 | 9.69 | 9.37 | 15.94 | 28.70 | 28.80 | 15.62 | 23.00 | 11.50 | 14.95 | 19.70 |
| June | 11.95 | 13.13 | 16.25 | 11.62 | 14.50 | 13.15 | 10.38 | 12.12 | 10.44 | 9.75 | 9.44 | 14.80 | 36.50 | 29.00 | 16.69 | 22.95 | 10.81 | 14.56 | 17.88 |
| July | 12.75 | 13.13 | 16.12 | 11.75 | 14.06 | 12.38 | 10.69 | 11.69 | 10.50 | 9.75 | 10.40 | 14.50 | 33.00 | 29.00 | 19.40 | 24.13 | 10.00 | 15.25 | 17.05 |
| August | 13.15 | 14.10 | 15.10 | 12.88 | 15.00 | 12.25 | 11.05 | 12.25 | 10.56 | 9.69 | 11.56 | 15.25 | 29.60 | 29.00 | 20.88 | 25.35 | 10.60 | 15.95 | 16.00 |
| September | 14.38 | 16.50 | 14.75 | 13.00 | 16.00 | 12.25 | 10.70 | 12.81 | 10.06 | 9.19 | 11.75 | 16.06 | 31.25 | 29.00 | 19.10 | 24.81 | 11.31 | 18.13 | 16.31 |
| October | 14.50 | 16.60 | 14.70 | 13.45 | 16.43 | 12.25 | 10.00 | 13.95 | 10.00 | 8.50 | 11.75 | 16.81 | 26.00 | 29.00 | 18.25 | 21.50 | 12.44 | 18.40 | 14.15 |
| November | 15.20 | 17.50 | 12.63 | 14.88 | 16.00 | 12.25 | 9.75 | 13.69 | 9.56 | 8.06 | 13.44 | 20.60 | 27.60 | 28.50 | 20.88 | 18.45 | 12.25 | 17.31 | 14.00 |
| December | 15.25 | 17.13 | 11.50 | 15.17 | 16.00 | 12.10 | 10.25 | 12.88 | 9.00 | 8.43 | 15.63 | 23.00 | 28.37 | 22.75 | 21.80 | 16.20 | 11.13 | 17.25 | 16.06 |
| *Average* | *13.96* | *14.74* | *15.08* | *12.45* | *14.45* | *13.43* | *10.92* | *12.12* | *10.89* | *9.38* | *10.91* | *16.68* | *27.86* | *28.66* | *18.09* | *22.82* | *11.98* | *15.06* | *18.05* |

## *Old Steel Rerolling Rails, per Gross Ton*

| | 1905 | 1906 | 1907 | 1908 | 1909 | 1910 | 1911 | 1912 | 1913 | 1914 | 1915 | 1916 | 1917 | 1918 | 1919 | 1920 | 1921 | 1922 | 1923 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| January | $16.00 | $16.50 | $19.00 | $12.30 | $15.81 | $18.00 | $13.69 | $13.00 | $16.15 | $11.10 | $ 9.62 | $17.06 | $27.00 | $35.00 | $22.10 | $34.25 | $15.63 | $12.10 | $20.40 |
| February | 15.13 | 16.25 | 19.00 | 13.00 | 15.12 | 18.00 | 13.63 | 12.80 | 15.50 | 11.81 | 9.87 | 17.06 | 27.00 | 35.00 | 16.44 | 34.38 | 15.50 | 12.00 | 21.75 |
| March | 15.30 | 15.70 | 19.00 | 12.19 | 13.06 | 17.80 | 13.65 | 12.75 | 15.00 | 11.56 | 10.25 | 17.65 | 28.00 | 34.75 | 16.38 | 32.30 | 13.30 | 13.31 | 24.63 |
| April | 15.44 | 15.75 | 18.50 | 12.60 | 13.20 | 17.69 | 13.44 | 12.88 | 14.63 | 11.50 | 10.25 | 18.00 | 32.62 | 33.50 | 17.55 | 32.13 | 12.63 | 14.50 | 23.75 |
| May | 14.06 | 16.00 | 18.60 | 12.94 | 14.44 | 17.12 | 13.49 | 13.50 | 13.95 | 11.31 | 10.25 | 17.38 | 36.50 | 34.00 | 17.75 | 31.75 | 13.40 | 15.70 | 21.70 |
| June | 12.95 | 15.88 | 18.94 | 13.94 | 15.50 | 16.50 | 12.38 | 13.50 | 12.69 | 11.50 | 10.25 | 15.85 | 46.90 | 34.00 | 18.75 | 32.65 | 12.94 | 15.25 | 19.25 |
| July | 13.56 | 15.50 | 18.00 | 14.50 | 15.40 | 15.88 | 12.25 | 13.50 | 12.25 | 11.50 | 10.30 | 15.25 | 45.19 | 34.00 | 25.15 | 35.00 | 12.25 | 16.13 | 18.00 |
| August | 14.35 | 15.90 | 17.00 | 15.63 | 16.12 | 15.31 | 12.65 | 14.00 | 12.12 | 11.50 | 12.25 | 15.80 | 39.20 | 34.00 | 29.50 | 38.00 | 12.45 | 16.90 | 17.50 |
| September | 15.25 | 17.63 | 16.75 | 16.18 | 17.15 | 15.25 | 12.75 | 15.00 | 12.25 | 10.75 | 13.35 | 17.06 | 39.75 | 34.00 | 26.80 | 38.13 | 13.13 | 19.38 | 17.38 |
| October | 15.63 | 18.63 | 17.15 | 15.80 | 18.00 | 15.25 | 12.44 | 16.30 | 12.15 | 10.00 | 13.31 | 18.81 | 34.75 | 34.00 | 27.19 | 33.44 | 14.00 | 20.30 | 15.80 |
| November | 16.30 | 21.15 | 15.06 | 17.19 | 18.00 | 15.06 | 12.30 | 16.50 | 12.00 | 9.50 | 14.44 | 24.50 | 34.80 | 33.50 | 31.25 | 22.90 | 13.80 | 18.38 | 15.05 |
| December | 16.50 | 21.00 | 12.94 | 16.95 | 18.00 | 14.20 | 12.50 | 16.50 | 11.33 | 9.50 | 16.63 | 28.63 | 35.25 | 27.50 | 31.90 | 16.90 | 12.63 | 17.75 | 17.00 |
| *Average* | *15.04* | *17.16* | *17.50* | *14.44* | *15.82* | *16.34* | *12.93* | *14.19* | *13.34* | *10.96* | *11.73* | *18.59* | *35.58* | *33.60* | *23.40* | *31.90* | *13.47* | *15.98* | *19.35* |

## *No. 1 Railroad Wrought, per Net Ton*

| | 1905 | 1906 | 1907 | 1908 | 1909 | 1910 | 1911 | 1912 | 1913 | 1914 | 1915 | 1916 | 1917 | 1918 | 1919 | 1920 | 1921 | 1922 | 1923 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| January | $18.19 | $17.30 | $16.35 | $11.20 | $13.81 | $14.88 | $11.75 | $11.63 | $12.70 | $8.70 | $8.69 | $15.88 | $23.50 | $31.25 | $19.10 | $26.00 | $13.63 | $10.50 | $17.75 |
| February | 17.00 | 15.88 | 15.50 | 12.44 | 12.88 | 14.60 | 12.00 | 11.30 | 12.19 | 9.50 | 8.87 | 14.94 | 23.75 | 31.25 | 15.13 | 27.00 | 13.50 | 10.44 | 18.38 |
| March | 16.40 | 14.88 | 15.25 | 11.25 | 11.43 | 14.45 | 12.30 | 11.44 | 12.13 | 9.06 | 9.00 | 16.20 | 25.90 | 30.75 | 15.88 | 27.10 | 11.60 | 11.50 | 20.88 |
| April | 16.06 | 14.50 | 15.25 | 11.00 | 11.90 | 14.19 | 11.69 | 12.31 | 12.38 | 9.00 | 8.65 | 17.00 | 30.35 | 30.20 | 16.05 | 27.25 | 10.00 | 12.13 | 20.00 |
| May | 14.19 | 14.50 | 15.45 | 10.75 | 12.81 | 12.87 | 11.38 | 12.75 | 11.25 | 9.00 | 8.94 | 16.50 | 32.60 | 29.75 | 15.69 | 26.38 | 10.40 | 12.90 | 17.60 |
| June | 13.50 | 13.50 | 16.06 | 11.69 | 13.38 | 12.75 | 11.25 | 12.57 | 10.56 | 9.00 | 9.00 | 15.20 | 41.00 | 29.75 | 16.87 | 25.25 | 9.63 | 12.69 | 15.50 |
| July | 14.13 | 13.50 | 15.06 | 12.15 | 13.16 | 12.44 | 11.00 | 12.06 | 10.55 | 9.00 | 9.15 | 14.94 | 37.75 | 29.75 | 18.60 | 24.88 | 9.25 | 13.63 | 14.60 |
| August | 15.45 | 14.50 | 14.40 | 12.69 | 14.44 | 11.94 | 11.10 | 12.50 | 10.62 | 8.94 | 10.44 | 15.30 | 33.70 | 29.75 | 20.75 | 24.75 | 10.45 | 14.75 | 14.25 |
| September | 16.31 | 16.13 | 14.38 | 13.44 | 15.35 | 11.94 | 10.94 | 13.13 | 10.19 | 8.37 | 11.00 | 16.38 | 35.50 | 29.75 | 19.50 | 23.88 | 11.50 | 17.62 | 15.63 |
| October | 17.00 | 17.50 | 14.60 | 13.60 | 15.94 | 11.75 | 10.44 | 14.25 | 9.60 | 7.87 | 11.19 | 17.50 | 28.75 | 30.36 | 19.38 | 20.25 | 13.00 | 17.75 | 13.20 |
| November | 17.50 | 18.00 | 12.32 | 14.38 | 15.31 | 11.94 | 10.20 | 13.50 | 9.00 | 7.56 | 12.94 | 21.00 | 30.90 | 28.68 | 22.88 | 16.85 | 12.20 | 15.81 | 12.50 |
| December | 18.00 | 17.25 | 11.00 | 14.83 | 14.75 | 11.65 | 10.75 | 13.06 | 8.50 | 7.90 | 15.38 | 25.13 | 31.25 | 24.62 | 24.10 | 14.60 | 10.44 | 15.13 | 15.00 |
| *Average* | *16.14* | *15.62* | *14.64* | *12.45* | *13.76* | *12.96* | *11.23* | *12.54* | *10.81* | *8.66* | *10.27* | *17.16* | *31.25* | *29.66* | *18.66* | *23.68* | *11.30* | *13.74* | *16.27* |

## *No. 1 Cast Scrap, per Net Ton*

| | 1905 | 1906 | 1907 | 1908 | 1909 | 1910 | 1911 | 1912 | 1913 | 1914 | 1915 | 1916 | 1917 | 1918 | 1919 | 1920 | 1921 | 1922 | 1923 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| January | $13.81 | $14.70 | $17.80 | $12.95 | $13.06 | $14.88 | $12.19 | $11.25 | $12.90 | $10.20 | $9.19 | $13.31 | $15.50 | $25.90 | $22.95 | $37.25 | $17.25 | $12.90 | $21.60 |
| February | 13.13 | 13.50 | 18.25 | 13.00 | 12.75 | 14.88 | 12.13 | 11.25 | 12.69 | 10.87 | 9.00 | 12.81 | 15.37 | 26.06 | 20.00 | 38.88 | 18.00 | 13.25 | 23.63 |
| March | 13.40 | 12.75 | 19.50 | 12.12 | 12.19 | 14.50 | 12.25 | 11.31 | 12.50 | 10.37 | 9.00 | 13.45 | 16.90 | 27.25 | 21.63 | 37.85 | 14.90 | 14.13 | 26.25 |
| April | 13.81 | 12.94 | 18.88 | 12.05 | 12.00 | 13.69 | 11.81 | 12.06 | 12.44 | 10.25 | 9.00 | 12.88 | 20.43 | 27.12 | 21.45 | 37.25 | 13.25 | 14.88 | 25.75 |
| May | 12.50 | 13.40 | 18.55 | 11.50 | 13.31 | 13.13 | 11.00 | 12.20 | 11.60 | 10.06 | 9.00 | 12.56 | 23.20 | 26.70 | 20.12 | 37.38 | 13.60 | 16.20 | 23.30 |
| June | 12.40 | 13.50 | 18.94 | 12.00 | 13.81 | 13.00 | 10.75 | 11.81 | 10.63 | 9.75 | 9.00 | 11.75 | 30.00 | 27.12 | 20.75 | 36.30 | 12.75 | 16.06 | 21.75 |
| July | 13.38 | 13.50 | 18.44 | 12.15 | 13.44 | 13.00 | 10.50 | 11.75 | 10.70 | 9.65 | 9.25 | 11.50 | 29.25 | 28.06 | 23.30 | 36.50 | 12.25 | 17.00 | 19.60 |
| August | 13.20 | 14.00 | 16.75 | 12.75 | 14.06 | 12.75 | 10.55 | 12.15 | 10.87 | 9.50 | 9.62 | 11.50 | 24.20 | 29.10 | 24.50 | 36.20 | 12.60 | 18.60 | 18.00 |
| September | 13.38 | 15.38 | 16.81 | 12.88 | 14.75 | 12.75 | 10.10 | 12.81 | 10.62 | 9.19 | 10.10 | 12.13 | 23.75 | 30.00 | 24.20 | 34.00 | 13.44 | 21.38 | 19.63 |
| October | 13.63 | 15.90 | 16.25 | 13.25 | 15.63 | 12.50 | 10.25 | 14.20 | 10.40 | 9.00 | 10.50 | 13.50 | 20.50 | 30.36 | 25.00 | 28.75 | 13.88 | 20.80 | 18.70 |
| November | 14.30 | 17.50 | 14.00 | 13.75 | 15.12 | 12.50 | 10.35 | 13.50 | 10.06 | 8.56 | 12.13 | 15.55 | 22.00 | 28.87 | 28.12 | 23.00 | 13.50 | 20.25 | 18.38 |
| December | 15.00 | 17.50 | 13.00 | 13.92 | 14.75 | 12.30 | 11.00 | 13.25 | 9.83 | 9.00 | 13.75 | 16.25 | 23.50 | 25.75 | 32.35 | 18.70 | 12.63 | 19.75 | 19.75 |
| *Average* | *13.50* | *14.55* | *17.26* | *12.69* | *13.79* | *13.32* | *11.07* | *12.30* | *11.27* | *9.70* | *9.96* | *13.10* | *22.05* | *27.69* | *23.70* | *33.51* | *14.00* | *17.10* | *21.36* |

## *Cast Borings, Per Net Ton*

| | 1913 | 1914 | 1915 | 1916 | 1917 | 1918 | 1919 | 1920 | 1921 | 1922 | 1923 |
|---|---|---|---|---|---|---|---|---|---|---|---|
| January | $6.95 | $4.15 | $4.63 | $7.75 | $9.00 | $16.50 | $11.20 | $14.38 | $9.75 | $5.70 | $13.90 |
| February | 6.50 | 5.37 | 4.75 | 7.38 | 9.06 | 16.50 | 7.81 | 14.63 | 10.50 | 6.19 | 14.81 |
| March | 6.63 | 4.69 | 4.75 | 7.40 | 9.50 | 16.50 | 9.06 | 14.05 | 7.50 | 7.19 | 16.88 |
| April | 6.69 | 4.50 | 4.80 | 7.00 | 10.56 | 16.06 | 9.35 | 14.25 | 6.50 | 8.25 | 16.00 |
| May | 5.55 | 4.50 | 5.00 | 6.75 | 12.00 | 15.65 | 8.31 | 12.88 | 5.90 | 9.80 | 14.50 |
| June | 4.81 | 4.50 | 5.00 | 5.75 | 17.50 | 15.87 | 9.31 | 11.95 | 5.00 | 10.38 | 12.88 |
| July | 4.80 | 4.50 | 5.15 | 5.69 | 17.87 | 16.50 | 11.35 | 12.63 | 4.75 | 11.31 | 12.20 |
| August | 5.00 | 4.50 | 5.75 | 6.05 | 16.40 | 16.50 | 12.75 | 13.45 | 4.80 | 11.50 | 10.75 |
| September | 4.69 | 4.75 | 6.40 | 6.50 | 16.25 | 16.50 | 12.10 | 13.08 | 5.00 | 12.88 | 10.88 |
| October | 4.50 | 4.75 | 6.50 | 6.81 | 14.06 | 16.50 | 10.38 | 11.50 | 5.75 | 13.30 | 9.30 |
| November | 4.31 | 4.56 | 6.56 | 7.50 | 15.40 | 15.00 | 11.50 | 10.65 | 6.10 | 13.00 | 9.00 |
| December | 3.91 | 4.50 | 7.55 | 9.19 | 16.12 | 13.25 | 12.65 | 9.80 | 5.44 | 13.00 | 10.75 |
| *Average* | *5.36* | *4.61* | *5.57* | *6.98* | *13.64* | *15.94* | *10.48* | *12.77* | *6.42* | *10.21* | *12.65* |

## *Railroad Malleable Scrap, per Net Ton*

| | 1905 | 1906 | 1907 | 1908 | 1909 | 1910 | 1911 | 1912 | 1913 | 1914 | 1915 | 1916 | 1917 | 1918 | 1919 | 1920 | 1921 | 1922 | 1923 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| January | $14.06 | $15.00 | $17.20 | $10.40 | $12.88 | $15.00 | $10.94 | $10.88 | $13.40 | $9.25 | $8.13 | $13.81 | $17.75 | $26.80 | $17.60 | $29.00 | $14.75 | $11.40 | $22.55 |
| February | 13.69 | 14.25 | 16.00 | 11.31 | 12.38 | 14.69 | 10.50 | 10.38 | 13.00 | 10.38 | 8.00 | 13.33 | 17.31 | 26.80 | 14.87 | 29.94 | 15.50 | 11.44 | 23.88 |
| March | 13.44 | 13.00 | 16.25 | 10.00 | 11.50 | 14.50 | 11.00 | 10.44 | 13.00 | 9.56 | 7.94 | 13.95 | 17.95 | 27.89 | 16.13 | 28.50 | 13.80 | 12.38 | 25.50 |
| April | 13.25 | 13.38 | 16.38 | 10.10 | 11.25 | 13.69 | 11.00 | 11.19 | 13.19 | 9.15 | 8.00 | 13.89 | 20.37 | 28.25 | 15.80 | 27.63 | 12.13 | 14.00 | 25.00 |
| May | 12.38 | 13.50 | 16.25 | 9.81 | 12.38 | 12.94 | 10.38 | 11.55 | 12.10 | 9.13 | 8.14 | 13.44 | 23.30 | 29.30 | 15.25 | 26.50 | 12.60 | 15.00 | 22.80 |
| June | 11.90 | 13.50 | 17.50 | 10.25 | 12.94 | 12.20 | 10.10 | 11.75 | 11.08 | 9.00 | 8.13 | 11.73 | 31.63 | 29.50 | 16.00 | 25.65 | 11.50 | 14.94 | 21.50 |
| July | 12.31 | 13.38 | 16.75 | 11.40 | 12.75 | 11.25 | 10.00 | 11.75 | 10.60 | 9.00 | 8.90 | 11.63 | 30.12 | 29.71 | 18.70 | 27.00 | 11.19 | 15.63 | 20.10 |
| August | 13.15 | 13.60 | 16.00 | 12.06 | 13.69 | 11.00 | 10.05 | 12.05 | 10.38 | 8.88 | 10.00 | 11.25 | 29.70 | 30.36 | 20.50 | 28.75 | 12.00 | 17.00 | 18.38 |
| September | 14.19 | 15.00 | 16.00 | 12.38 | 15.15 | 11.20 | 10.00 | 12.56 | 10.19 | 8.25 | 10.25 | 11.50 | 30.75 | 30.36 | 18.95 | 27.63 | 13.06 | 21.13 | 19.38 |
| October | 14.25 | 15.13 | 16.20 | 12.45 | 15.25 | 11.00 | 9.69 | 13.75 | 9.65 | 7.90 | 10.25 | 12.38 | 25.25 | 30.36 | 19.06 | 23.50 | 13.50 | 21.80 | 17.50 |
| November | 14.55 | 17.30 | 12.25 | 13.44 | 15.13 | 11.25 | 9.50 | 13.56 | 9.31 | 7.75 | 11.38 | 16.00 | 25.60 | 29.18 | 23.12 | 19.45 | 13.10 | 20.63 | 16.88 |
| December | 15.00 | 18.00 | 10.50 | 13.70 | 14.95 | 11.25 | 10.06 | 13.50 | 9.00 | 7.95 | 13.75 | 18.00 | 27.35 | 22.75 | 25.70 | 15.00 | 11.44 | 20.00 | 18.06 |
| *Average* | *13.51* | *14.59* | *15.61* | *11.44* | *13.35* | *12.50* | *10.27* | *11.94* | *11.24* | *8.85* | *9.41* | *13.41* | *24.76* | *28.44* | *18.47* | *25.71* | *12.88* | *16.28* | *21.96* |

## *Old Cast Iron Carwheels, per Gross Ton*

| | 1905 | 1906 | 1907 | 1908 | 1909 | 1910 | 1911 | 1912 | 1913 | 1914 | 1915 | 1916 | 1917 | 1918 | 1919 | 1920 | 1921 | 1922 | 1923 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| January | $16.56 | $19.00 | $24.90 | $20.10 | $15.75 | $18.38 | $13.00 | $13.25 | $16.95 | $11.65 | $9.94 | $14.63 | $18.87 | $30.00 | $25.90 | $36.13 | $21.00 | $15.30 | $26.70 |
| February | 16.38 | 19.00 | 23.50 | 16.94 | 15.25 | 17.88 | 13.00 | 13.05 | 16.75 | 12.44 | 10.00 | 13.94 | 18.25 | 30.00 | 22.75 | 38.06 | 20.63 | 15.00 | 27.25 |
| March | 16.75 | 18.60 | 23.88 | 15.50 | 14.00 | 17.00 | 13.25 | 13.00 | 16.75 | 11.88 | 9.94 | 14.30 | 20.25 | 30.00 | 21.50 | 36.20 | 15.90 | 16.50 | 28.38 |
| April | 15.88 | 18.75 | 25.00 | 14.00 | 14.50 | 16.50 | 13.25 | 13.25 | 16.75 | 11.55 | 9.75 | 13.88 | 23.62 | 29.00 | 21.50 | 37.50 | 14.06 | 18.63 | 27.75 |
| May | 14.81 | 19.00 | 25.20 | 12.88 | 14.81 | 15.75 | 12.75 | 13.90 | 15.05 | 11.50 | 9.75 | 12.95 | 27.35 | 29.00 | 21.25 | 37.50 | 14.70 | 18.50 | 24.10 |
| June | 14.25 | 18.00 | 25.38 | 13.00 | 15.81 | 15.50 | 12.55 | 14.13 | 13.94 | 11.50 | 10.19 | 12.44 | 39.00 | 20.00 | 22.00 | 35.90 | 13.31 | 18.25 | 21.88 |
| July | 14.38 | 18.00 | 24.25 | 13.30 | 16.00 | 14.81 | 12.50 | 13.88 | 12.90 | 11.25 | 11.30 | 12.50 | 35.25 | 29.00 | 23.95 | 35.75 | 12.75 | 19.25 | 20.60 |
| August | 14.95 | 18.50 | 24.50 | 15.50 | 16.25 | 14.50 | 12.85 | 13.70 | 12.75 | 11.25 | 11.04 | 11.60 | 30.40 | 29.00 | 26.25 | 38.35 | 12.95 | 20.60 | 19.50 |
| September | 15.75 | 19.75 | 24.50 | 15.50 | 18.05 | 14.00 | 12.81 | 14.38 | 12.63 | 11.06 | 11.80 | 11.69 | 31.87 | 29.00 | 24.90 | 37.69 | 14.19 | 23.75 | 19.75 |
| October | 16.00 | 19.31 | 24.38 | 15.25 | 18.31 | 14.00 | 12.50 | 16.00 | 13.10 | 10.65 | 12.00 | 12.94 | 25.75 | 29.00 | 24.88 | 36.06 | 16.50 | 25.10 | 17.90 |
| November | 17.10 | 22.60 | 23.13 | 15.50 | 18.50 | 13.50 | 12.10 | 16.60 | 12.00 | 9.81 | 13.31 | 17.30 | 28.15 | 29.00 | 28.63 | 31.95 | 16.60 | 24.63 | 17.88 |
| December | 18.75 | 25.00 | 22.00 | 16.00 | 18.50 | 13.50 | 13.06 | 16.75 | 11.88 | 9.60 | 11.56 | 21.25 | 31.00 | 26.75 | 31.10 | 24.40 | 15.75 | 24.00 | 19.75 |
| *Average* | *15.88* | *19.03* | *24.22* | *15.20* | *16.37* | *15.44* | *12.80* | *14.33* | *14.20* | *11.18* | *11.13* | *14.12* | *27.48* | *29.06* | *24.55* | *35.46* | *15.70* | *19.98* | *22.62* |

## Philadelphia Scrap Prices, 1903 to 1923

**These Prices, Delivered Eastern Pennsylvania, Are Averaged from Weekly Quotations in THE IRON AGE**

### *Heavy Melting Steel Scrap, per Gross Ton*

| | 1903 | 1904 | 1905 | 1906 | 1907 | 1908 | 1909 | 1910 | 1911 | 1912 | 1913 | 1914 | 1915 | 1916 | 1917 | 1918 | 1919 | 1920 | 1921 | 1922 | 1923 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| January... | $20.00 | $11.56 | $17.44 | $17.33 | $18.61 | $11.70 | $16.94 | $17.00 | $12.50 | $12.19 | $14.40 | $10.40 | $10.00 | $16.38 | $21.70 | $30.00 | $17.20 | $24.75 | $14.50 | $11.60 | $19.70 |
| February.. | 20.19 | 12.56 | 17.37 | 16.62 | 18.69 | 14.25 | 15.58 | 16.62 | 13.50 | 11.70 | 12.87 | 11.00 | 10.00 | 16.50 | 20.63 | 30.00 | 14.75 | 25.63 | 14.25 | 12.00 | 20.75 |
| March.... | 20.75 | 14.00 | 17.62 | 15.80 | 18.87 | 13.12 | 13.50 | 16.50 | 14.05 | 11.80 | 13.25 | 11.31 | 10.80 | 16.90 | 23.50 | 29.00 | 14.19 | 25.20 | 13.00 | 12.78 | 25.25 |
| April...... | 20.75 | 14.69 | 17.56 | 16.69 | 18.75 | 12.75 | 13.25 | 16.12 | 13.31 | 12.94 | 13.34 | 10.95 | 11.00 | 17.88 | 24.88 | 28.00 | 15.50 | 24.12 | 11.25 | 14.00 | 23.63 |
| May....... | 20.56 | 12.50 | 15.94 | 16.30 | 18.95 | 12.81 | 14.75 | 14.75 | 13.00 | 13.50 | 12.10 | 10.63 | 11.25 | 16.60 | 25.40 | 29.00 | 15.00 | 23.37 | 11.80 | 14.75 | 19.80 |
| June...... | 20.50 | 11.35 | 14.55 | 15.75 | 18.75 | 13.25 | 15.81 | 14.45 | 13.00 | 13.50 | 11.75 | 10.50 | 11.10 | 15.31 | 34.13 | 29.00 | 16.12 | 22.60 | 11.25 | 15.00 | 17.88 |
| July...... | 19.00 | 11.12 | 15.16 | 15.87 | 17.62 | 13.80 | 15.80 | 14.12 | 13.19 | 13.50 | 11.35 | 10.30 | 12.06 | 14.94 | 35.20 | 29.00 | 18.90 | 22.62 | 11.00 | 15.00 | 16.60 |
| August.... | 17.37 | 11.75 | 15.55 | 16.75 | 16.85 | 14.50 | 16.87 | 13.75 | 13.15 | 13.65 | 11.43 | 10.19 | 13.75 | 14.75 | 31.88 | 29.00 | 19.37 | 25.00 | 11.40 | 15.20 | 16.00 |
| September. | 15.87 | 11.90 | 15.69 | 17.94 | 16.50 | 15.19 | 17.40 | 13.85 | 12.50 | 14.50 | 11.62 | 10.69 | 15.00 | 14.75 | 30.25 | 29.00 | 19.62 | 25.62 | 11.50 | 16.88 | 16.75 |
| October... | 13.85 | 12.87 | 16.56 | 18.12 | 15.35 | 15.00 | 18.00 | 13.81 | 11.94 | 15.10 | 11.15 | 9.95 | 14.75 | 15.63 | 35.00 | 29.00 | 19.10 | 22.75 | 12.06 | 17.80 | 15.40 |
| November. | 11.87 | 14.75 | 17.55 | 18.70 | 12.94 | 15.75 | 18.00 | 13.50 | 11.55 | 15.50 | 10.19 | 9.25 | 14.65 | 20.13 | 36.00 | 28.00 | 20.63 | 19.00 | 11.88 | 16.25 | 15.25 |
| December. | 11.25 | 16.20 | 17.50 | 19.50 | 11.50 | 17.10 | 17.50 | 12.65 | 12.08 | 15.25 | 10.00 | 9.40 | 15.81 | 23.75 | 38.20 | 25.00 | 22.50 | 15.25 | 11.50 | 16.38 | 16.75 |
| *Average..* | *17.66* | *12.94* | *16.54* | *17.11* | *16.95* | *14.10* | *16.12* | *14.76* | *12.81* | *13.69* | *11.96* | *10.38* | *12.51* | *16.96* | *27.23* | *28.67* | *17.66* | *22.99* | *12.12* | *14.80* | *18.65* |

### *No. 1 Machinery Cast Scrap, per Gross Ton*

| | 1903 | 1904 | 1905 | 1906 | 1907 | 1908 | 1909 | 1910 | 1911 | 1912 | 1913 | 1914 | 1915 | 1916 | 1917 | 1918 | 1919 | 1920 | 1921 | 1922 | 1923 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| January... | $19.75 | $12.75 | $16.00 | $16.00 | $21.70 | $15.30 | $15.87 | $17.00 | $14.00 | $13.42 | $14.50 | $12.00 | $12.00 | $17.00 | $20.20 | $30.00 | $23.80 | $36.00 | $23.25 | $16.50 | $23.20 |
| February.. | 19.81 | 12.81 | 15.62 | 15.87 | 22.00 | 15.00 | 15.00 | 16.12 | 14.38 | 13.00 | 14.37 | 12.88 | 12.00 | 17.00 | 20.00 | 30.00 | 23.00 | 40.00 | 23.00 | 16.50 | 24.25 |
| March.... | 20.00 | 13.30 | 15.75 | 15.50 | 22.25 | 15.00 | 14.00 | 16.00 | 14.40 | 13.12 | 14.00 | 13.00 | 12.00 | 17.00 | 21.75 | 30.00 | 21.25 | 39.20 | 19.40 | 17.13 | 28.25 |
| April...... | 20.00 | 13.37 | 16.00 | 15.50 | 21.25 | 15.00 | 14.10 | 15.87 | 13.44 | 13.62 | 13.94 | 13.00 | 11.75 | 17.88 | 26.63 | 29.00 | 22.00 | 38.00 | 18.00 | 17.25 | 26.25 |
| May....... | 19.25 | 12.50 | 15.19 | 15.40 | 20.80 | 14.87 | 14.69 | 15.06 | 13.13 | 13.75 | 13.60 | 12.25 | 12.13 | 17.50 | 29.00 | 29.00 | 21.50 | 37.75 | 18.00 | 18.40 | 24.30 |
| June...... | 18.37 | 11.60 | 14.20 | 15.37 | 20.75 | 14.25 | 15.00 | 15.00 | 13.00 | 13.75 | 13.25 | 12.00 | 12.25 | 16.50 | 33.50 | 29.00 | 22.00 | 37.00 | 17.38 | 19.00 | 22.25 |
| July...... | 17.50 | 11.25 | 14.00 | 15.12 | 19.25 | 14.00 | 14.85 | 14.94 | 13.06 | 13.75 | 13.00 | 12.00 | 12.38 | 16.00 | 36.30 | 29.00 | 22.10 | 37.50 | 16.50 | 17.50 | 20.40 |
| August.... | 15.87 | 11.50 | 14.40 | 16.30 | 18.60 | 14.25 | 15.37 | 14.25 | 13.20 | 13.75 | 12.87 | 12.00 | 13.30 | 16.00 | 33.25 | 29.00 | 24.75 | 39.00 | 17.00 | 18.60 | 20.38 |
| September. | 14.75 | 11.50 | 15.12 | 17.44 | 18.00 | 15.25 | 15.90 | 14.00 | 12.69 | 14.96 | 12.81 | 12.00 | 14.00 | 16.00 | 31.00 | 29.00 | 25.00 | 39.25 | 17.00 | 21.50 | 21.38 |
| October... | 13.90 | 12.37 | 15.75 | 18.37 | 17.60 | 15.25 | 16.94 | 14.00 | 12.44 | 14.50 | 13.50 | 11.40 | 14.00 | 16.15 | 28.00 | 29.00 | 25.20 | 38.75 | 17.13 | 22.60 | 19.50 |
| November. | 12.87 | 13.75 | 16.00 | 19.20 | 16.50 | 15.44 | 17.50 | 14.00 | 12.25 | 14.75 | 12.62 | 11.00 | 14.50 | 18.50 | 30.00 | 29.00 | 27.62 | 33.80 | 17.50 | 21.00 | 19.25 |
| December. | 12.50 | 14.90 | 16.00 | 21.12 | 15.50 | 16.00 | 17.50 | 14.00 | 13.00 | 15.00 | 13.17 | 11.30 | 16.06 | 20.75 | 30.60 | 29.00 | 30.75 | 24.56 | 16.63 | 20.25 | 20.25 |
| *Average..* | *17.05* | *12.63* | *15.34* | *16.43* | *19.52* | *14.97* | *15.56* | *15.02* | *13.25* | *13.95* | *13.39* | *12.07* | *13.03* | *17.19* | *28.35* | *29.25* | *24.08* | *36.73* | *18.49* | *18.85* | *22.47* |

### *No. 1 Railroad Wrought, per Gross Ton*

| | 1903 | 1904 | 1905 | 1906 | 1907 | 1908 | 1909 | 1910 | 1911 | 1912 | 1913 | 1914 | 1915 | 1916 | 1917 | 1918 | 1919 | 1920 | 1921 | 1922 | 1923 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| January... | $22.40 | $15.12 | $20.75 | $21.16 | $22.55 | $14.30 | $19.50 | $19.56 | $15.63 | $15.37 | $16.10 | $13.05 | $12.00 | $22.00 | $26.60 | $35.00 | $24.20 | $33.50 | $20.00 | $14.50 | $22.10 |
| February.. | 22.87 | 15.75 | 21.50 | 19.87 | 21.50 | 15.94 | 17.75 | 18.94 | 16.06 | 14.00 | 15.12 | 14.38 | 12.00 | 21.63 | 25.50 | 35.00 | 21.50 | 36.00 | 19.75 | 14.63 | 24.75 |
| March.... | 23.25 | 17.20 | 22.37 | 19.20 | 21.12 | 15.31 | 15.00 | 19.00 | 17.20 | 14.12 | 15.25 | 14.00 | 12.50 | 22.13 | 30.75 | 35.00 | 20.25 | 35.90 | 17.20 | 15.38 | 27.50 |
| April...... | 23.45 | 17.75 | 22.50 | 20.00 | 20.50 | 15.00 | 15.25 | 18.69 | 16.06 | 15.44 | 15.37 | 13.25 | 12.69 | 23.38 | 36.00 | 35.00 | 21.60 | 35.00 | 17.00 | 15.88 | 27.00 |
| May....... | 22.50 | 15.75 | 18.75 | 19.20 | 20.60 | 15.00 | 17.12 | 17.50 | 15.25 | 15.75 | 15.00 | 12.63 | 12.94 | 22.50 | 41.40 | 34.00 | 21.00 | 33.50 | 15.20 | 16.90 | 24.20 |
| June ...... | 20.87 | 13.00 | 16.00 | 17.87 | 20.75 | 15.25 | 18.19 | 16.70 | 15.00 | 15.44 | 14.75 | 12.50 | 13.00 | 20.50 | 51.25 | 34.00 | 21.50 | 33.00 | 14.38 | 17.00 | 22.50 |
| July...... | 19.40 | 12.69 | 16.16 | 17.50 | 19.12 | 15.95 | 17.45 | 16.00 | 15.13 | 15.50 | 13.90 | 12.20 | 13.44 | 19.50 | 50.60 | 34.00 | 24.40 | 33.00 | 13.50 | 17.13 | 18.80 |
| August.... | 17.50 | 13.44 | 18.80 | 19.70 | 18.30 | 17.50 | 18.87 | 15.37 | 15.70 | 15.80 | 14.00 | 12.00 | 14.95 | 20.20 | 45.00 | 34.00 | 26.50 | 33.00 | 14.00 | 18.00 | 18.00 |
| September. | 17.00 | 14.45 | 20.50 | 21.25 | 18.00 | 18.25 | 19.95 | 16.10 | 14.75 | 16.31 | 14.68 | 12.38 | 16.50 | 20.00 | 44.00 | 34.00 | 26.50 | 33.25 | 15.00 | 20.88 | 18.50 |
| October... | 16.50 | 15.37 | 21.62 | 22.25 | 17.50 | 18.30 | 20.75 | 16.19 | 13.94 | 16.80 | 14.00 | 11.80 | 16.13 | 21.63 | 37.20 | 34.00 | 26.90 | 29.25 | 15.88 | 22.20 | 17.50 |
| November. | 15.25 | 17.00 | 22.70 | 22.25 | 15.75 | 19.19 | 20.75 | 16.00 | 13.85 | 17.06 | 13.00 | 11.50 | 16.50 | 24.13 | 35.00 | 34.00 | 28.37 | 25.00 | 16.00 | 19.00 | 17.38 |
| December. | 14.50 | 19.10 | 21.87 | 23.25 | 14.62 | 19.95 | 19.50 | 15.90 | 15.00 | 16.25 | 12.75 | 11.50 | 20.06 | 26.75 | 35.00 | 33.00 | 30.25 | 20.00 | 14.63 | 19.25 | 18.50 |
| *Average..* | *19.62* | *15.55* | *20.29* | *20.29* | *19.19* | *16.66* | *18.34* | *17.16* | *15.30* | *15.65* | *14.49* | *12.60* | *14.39* | *22.03* | *38.19* | *34.25* | *24.41* | *31.70* | *16.04* | *17.56* | *21.39* |

### *Old Cast Iron Carwheels, per Gross Ton*

| | 1903 | 1904 | 1905 | 1906 | 1907 | 1908 | 1909 | 1910 | 1911 | 1912 | 1913 | 1914 | 1915 | 1916 | 1917 | 1918 | 1919 | 1920 | 1921 | 1922 | 1923 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| January .. | $20.30 | $12.87 | $16.00 | $18.75 | $23.00 | $18.20 | $16.00 | $17.50 | $13.00 | $12.37 | $16.20 | $12.20 | $11.00 | $16.38 | $21.50 | $30.00 | $24.60 | $38.00 | $25.00 | $16.50 | $22.30 |
| February.. | 22.62 | 13.00 | 16.00 | 18.75 | 23.00 | 16.63 | 15.50 | 16.81 | 13.44 | 12.00 | 15.37 | 12.63 | 10.63 | 16.50 | 20.50 | 30.00 | 23.00 | 40.63 | 24.00 | 15.00 | 24.75 |
| March.... | 24.50 | 13.20 | 16.70 | 17.70 | 23.62 | 15.00 | 14.00 | 16.75 | 14.00 | 11.94 | 15.00 | 12.50 | 11.00 | 16.70 | 21.50 | 30.00 | 23.00 | 42.40 | 18.50 | 15.94 | 26.50 |
| April...... | 24.20 | 13.50 | 17.00 | 16.75 | 24.00 | 14.00 | 14.05 | 16.06 | 13.19 | 12.87 | 14.87 | 12.00 | 11.00 | 17.38 | 25.75 | 29.00 | 23.10 | 40.00 | 18.00 | 15.88 | 26.50 |
| May ...... | 23.62 | 12.00 | 16.00 | 16.75 | 24.80 | 14.00 | 14.25 | 15.12 | 13.00 | 13.90 | 13.75 | 11.75 | 11.38 | 16.70 | 28.00 | 29.00 | 21.00 | 40.00 | 16.80 | 16.70 | 24.20 |
| June ...... | 21.87 | 11.20 | 14.90 | 16.69 | 25.37 | 13.75 | 15.00 | 14.90 | 13.10 | 14.00 | 13.12 | 11.19 | 11.55 | 16.38 | 34.00 | 29.00 | 22.00 | 38.00 | 18.00 | 17.13 | 22.75 |
| July...... | 21.30 | 10.75 | 14.25 | 16.19 | 25.00 | 13.50 | 15.05 | 14.25 | 12.94 | 14.00 | 12.30 | 11.00 | 12.38 | 15.63 | 36.20 | 29.00 | 23.20 | 38.50 | 16.50 | 17.50 | 20.40 |
| August.... | 19.12 | 11.25 | 15.20 | 16.75 | 23.90 | 14.75 | 15.62 | 13.94 | 13.00 | 14.05 | 12.37 | 11.25 | 13.25 | 15.50 | 34.50 | 29.00 | 24.50 | 40.60 | 16.40 | 18.10 | 20.25 |
| September | 18.25 | 11.80 | 15.50 | 18.27 | 23.00 | 15.00 | 16.80 | 13.75 | 12.56 | 14.25 | 12.75 | 11.25 | 14.00 | 15.50 | 32.50 | 29.00 | 24.50 | 42.75 | 17.00 | 21.75 | 21.00 |
| October... | 16.40 | 12.37 | 16.37 | 20.94 | 22.40 | 15.00 | 17.50 | 13.75 | 11.75 | 14.87 | 12.46 | 10.10 | 13.75 | 15.88 | 29.00 | 29.00 | 24.50 | 40.50 | 17.00 | 22.50 | 19.60 |
| November. | 14.43 | 13.81 | 17.10 | 22.00 | 19.00 | 15.62 | 17.50 | 13.50 | 11.35 | 15.00 | 12.00 | 9.50 | 14.05 | 18.88 | 31.25 | 29.00 | 27.75 | 36.40 | 17.20 | 20.50 | 17.75 |
| December. | 12.75 | 14.60 | 18.12 | 23.00 | 19.00 | 16.00 | 17.50 | 13.25 | 12.33 | 15.50 | 12.00 | 10.00 | 15.63 | 22.38 | 32.40 | 28.00 | 30.50 | 26.00 | 16.63 | 20.00 | 19.50 |
| *Average..* | *19.95* | *12.53* | *16.10* | *18.55* | *23.01* | *15.12* | *15.73* | *14.97* | *12.81* | *13.73* | *13.52* | *11.28* | *12.47* | *16.98* | *28.93* | *29.17* | *24.30* | *38.48* | *18.42* | *18.13* | *22.13* |

## Scrap Prices at Pittsburgh, Dollars Per Gross Ton

### *Heavy Melting Steel*

| | 1903 | 1904 | 1905 | 1906 | 1907 | 1908 | 1909 | 1910 | 1911 | 1912 | 1913 | 1914 | 1915 | 1916 | 1917 | 1918 | 1919 | 1920 | 1921 | 1922 | 1923 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| January... | $21.20 | $12.50 | $16.25 | $17.25 | $18.95 | $12.80 | $16.63 | $17.69 | $13.50 | $12.75 | $14.95 | $10.90 | $11.63 | $17.50 | $22.60 | $30.00 | $19.00 | $26.30 | $15.50 | $14.30 | $21.80 |
| February.. | 21.13 | 13.50 | 15.88 | 16.31 | 18.06 | 13.88 | 15.63 | 17.25 | 14.13 | 12.12 | 14.19 | 12.63 | 11.63 | 17.06 | 21.75 | 30.00 | 14.75 | 27.75 | 16.00 | 14.00 | 23.25 |
| March.... | 21.00 | 14.00 | 15.90 | 14.70 | 18.00 | 13.19 | 14.19 | 16.80 | 14.35 | 12.62 | 14.19 | 12.12 | 12.00 | 18.45 | 23.25 | 30.00 | 14.00 | 27.25 | 14.00 | 15.13 | 25.38 |
| April...... | 21.50 | 13.63 | 16.00 | 14.75 | 17.94 | 12.80 | 14.00 | 16.50 | 13.06 | 13.06 | 14.19 | 12.00 | 11.81 | 17.81 | 28.00 | 28.50 | 15.20 | 26.00 | 12.63 | 16.38 | 25.88 |
| May....... | 21.25 | 12.13 | 15.00 | 14.80 | 18.10 | 12.81 | 14.81 | 15.30 | 12.62 | 13.25 | 13.55 | 12.00 | 11.75 | 16.95 | 28.80 | 28.50 | 14.75 | 25.00 | 13.30 | 17.30 | 22.80 |
| June...... | 20.00 | 11.30 | 13.90 | 15.63 | 18.38 | 13.13 | 15.69 | 15.10 | 12.95 | 13.44 | 12.62 | 12.00 | 11.75 | 15.88 | 41.00 | 28.62 | 17.12 | 25.00 | 12.69 | 17.00 | 21.13 |
| July...... | 19.70 | 10.75 | 14.00 | 15.75 | 18.06 | 14.25 | 15.90 | 14.50 | 13.06 | 13.34 | 12.40 | 12.00 | 12.31 | 16.31 | 39.00 | 29.00 | 19.70 | 26.00 | 12.00 | 17.38 | 18.10 |
| August.... | 18.50 | 11.38 | 14.85 | 16.50 | 17.75 | 14.81 | 16.31 | 14.31 | 13.20 | 13.55 | 12.37 | 11.50 | 13.81 | 16.05 | 32.83 | 29.00 | 21.00 | 28.13 | 12.70 | 17.75 | 17.75 |
| September. | 17.25 | 11.50 | 15.88 | 16.88 | 17.38 | 14.25 | 17.40 | 14.35 | 12.50 | 14.11 | 12.25 | 11.31 | 14.30 | 16.19 | 33.25 | 29.00 | 19.20 | 29.00 | 13.63 | 20.13 | 17.88 |
| October... | 15.30 | 12.25 | 16.50 | 17.13 | 17.10 | 15.20 | 17.94 | 14.25 | 12.06 | 15.85 | 11.85 | 10.85 | 14.38 | 18.25 | 28.80 | 29.00 | 19.00 | 27.75 | *14.13 | 21.40 | 15.70 |
| November. | 13 25 | 14.25 | 17.50 | 18.00 | 14.88 | 16.06 | 17.50 | 14.25 | 12.00 | 15.12 | 11.44 | 10.00 | 15.88 | 21.20 | 29.50 | 28,87 | 22.25 | 23.50 | 14.30 | 20.50 | 16.13 |
| December. | 11.20 | 16.20 | 17.63 | 20.00 | 13.00 | 16.70 | 18.00 | 13.75 | 12.31 | 14.75 | 11.08 | 10.75 | 17.45 | 26.00 | 30.00 | 26.87 | 24.25 | 17.20 | 14.25 | 20.13 | 18.75 |
| *Average..* | *18.44* | *12.78* | *15.77* | *16.48* | *17.30* | *14.51* | *16.17* | *15.34* | *12.98* | *13.66* | *12.92* | *11.50* | *13.23* | *18.14* | *29.90* | *28.95* | *18.35* | *25.74* | *13.76* | *17.62* | *20.38* |

### *No. 1 Cast Cupola Scrap*

| | 1914 | 1915 | 1916 | 1917 | 1918 | 1919 | 1920 | 1921 | 1922 | 1923 |
|---|---|---|---|---|---|---|---|---|---|---|
| Jan.... | $10.75 | $11.25 | $15.50 | $19.62 | $30.00 | $24.20 | $32.00 | $25.00 | $16.30 | $23.30 |
| Feb.... | 11.69 | 11.25 | 15.62 | 19.00 | 30.00 | 18.75 | 34.00 | 22.75 | 16.00 | 24.75 |
| March.. | 11.50 | 11.44 | 16.05 | 20.60 | 30.00 | 18.00 | 34.00 | 21.20 | 15.94 | 26.75 |
| April... | 11.50 | 11.90 | 16.12 | 23.75 | 29.00 | 19.00 | 33.00 | 18.00 | 16.88 | 27.75 |
| May... | 11.50 | 12.00 | 16.15 | 24.90 | 28.50 | 17.20 | 32.00 | 18.00 | 18.50 | 26.30 |
| June... | 11.37 | 12.12 | 15.90 | 34.75 | 28.62 | 18.50 | 32.00 | 16.63 | 18.75 | 24.13 |
| July.... | 11.45 | 12.15 | 15.50 | 34.25 | 29.00 | 20.40 | 40.20 | 16.00 | 19.00 | 21.10 |
| Aug.... | 11.25 | 12.62 | 14.80 | 31.60 | 29.00 | 28.50 | 41.25 | 16.20 | 19.00 | 21.38 |
| Sept... | 11.25 | 13.00 | 14.62 | 30.00 | 29.00 | 23.50 | 42.00 | 16.88 | 22.13 | 21.75 |
| Oct.... | 11.45 | 13.06 | 15.75 | 28.25 | 29.00 | 23.80 | 39.75 | 17.50 | 24.00 | 19.50 |
| Nov.... | 10.50 | 13.75 | 17.20 | 26.20 | 29.00 | 27.25 | 34.25 | 17.10 | 23.13 | 18.63 |
| Dec.... | 10.80 | 15.15 | 21.87 | 29.00 | 27.00 | 28.75 | 27.25 | 16.13 | 22.38 | 20.00 |
| *Aver.* | *11.25* | *12.48* | *15.93* | *26.83* | *29.01* | *21.90* | *35.14* | *18.45* | *19.33* | *22.95* |

### *Machine Shop Turnings*

| | 1914 | 1915 | 1916 | 1917 | 1918 | 1919 | 1920 | 1921 | 1922 | 1923 |
|---|---|---|---|---|---|---|---|---|---|---|
| Jan.... | $5.87 | $7.69 | $9.87 | $11.44 | $20.00 | $11.20 | $15.50 | $10.00 | $9.60 | $16.90 |
| Feb.... | 8.75 | 7.81 | 9.50 | 12.00 | 20.00 | 8.50 | 17.88 | 10.00 | 9.56 | 18.50 |
| March.. | 8.12 | 7.62 | 10.35 | 11.70 | 20.00 | 9.00 | 18.00 | 9.40 | 10.50 | 20.38 |
| April... | 7.55 | 7.85 | 10.60 | 13.44 | 18.50 | 10.12 | 16.70 | 8.13 | 11.88 | 20.50 |
| May... | 7.66 | 7.75 | 9.80 | 14.30 | 18.00 | 11.62 | 15.38 | 8.70 | 13.30 | 19.20 |
| June... | 7.75 | 7.94 | 9.10 | 20.75 | 18.00 | 9.68 | 14.75 | 7.56 | 13.32 | 17.19 |
| July.... | 7.75 | 7.95 | 8.21 | 20.50 | 18.80 | 11.60 | 13.40 | 7.00 | 14.00 | 12.10 |
| Aug.... | 8.25 | 8.25 | 7.50 | 18.00 | 19.00 | 13.50 | 15.25 | 7.85 | 14.00 | 11.44 |
| Sept... | 8.25 | 8.65 | 7.06 | 21.00 | 19.00 | 12.25 | 16.30 | 9.06 | 14.75 | 12.88 |
| Oct.... | 8.45 | 8.37 | 7.50 | 19.00 | 19.00 | 12.75 | 15.88 | 9.56 | 16.20 | 11.60 |
| Nov.... | 7.79 | 8.62 | 8.70 | 18.00 | 19.00 | 14.00 | 14.63 | 9.85 | 16.63 | 11.63 |
| Dec.... | 7.95 | 9.55 | 12.75 | 19.25 | 17.50 | 14.25 | 10.50 | 8.88 | 15.63 | 13.75 |
| *Aver.* | *7.85* | *8.17* | *9.25* | *16.66* | *18.90* | *11.54* | *15.35* | *8.83* | *13.28* | *15.51* |

### *Compressed Sheets*

| | 1914 | 1915 | 1916 | 1917 | 1918 | 1919 | 1920 | 1921 | 1922 | 1923 |
|---|---|---|---|---|---|---|---|---|---|---|
| Jan.... | $9.75 | $10.38 | $16.13 | $19.00 | $26.00 | $16.50 | $23.00 | $13.00 | $11.80 | $20.50 |
| Feb.... | 10.94 | 10.25 | 16.06 | 18.00 | 26.00 | 13.25 | 23.75 | 13.00 | 12.00 | 21.75 |
| March.. | 11.19 | 10.25 | 16.25 | 18.50 | 26.00 | 11.40 | 23.00 | 12.00 | 13.13 | 23.75 |
| April... | 10.70 | 10.25 | 16.00 | 21.50 | 24.40 | 13.00 | 22.13 | 10.50 | 14.63 | 24.75 |
| May... | 11.06 | 10.25 | 15.30 | 22.30 | 26.00 | 12.75 | 22.00 | 10.80 | 15.10 | 24.30 |
| June... | 11.06 | 10.55 | 14.75 | 31.50 | 27.25 | 14.30 | 22.00 | 10.13 | 15.13 | 19.88 |
| July.... | 11.00 | 11.63 | 14.25 | 31.40 | 29.00 | 15.00 | 21.50 | 9.38 | 15.50 | 16.90 |
| Aug.... | 10.50 | 12.69 | 13.50 | 25.75 | 29.00 | 17.88 | 23.90 | 10.00 | 16.10 | 16.13 |
| Sept... | 10.00 | 13.00 | 13.50 | 25.00 | 29.00 | 18.00 | 24.25 | 10.06 | 17.88 | 16.00 |
| Oct.... | 9.50 | 13.00 | 14.25 | 23.00 | 29.00 | 18.00 | 22.75 | 12.00 | 19.50 | 14.30 |
| Nov.... | 9.00 | 13.55 | 16.60 | 22.00 | 29.00 | 18.00 | 19.80 | 12.00 | 19.50 | 14.25 |
| Dec.... | 9.35 | 16.00 | 21.25 | 25.50 | 23.80 | 19.80 | 14.75 | 11.69 | 19.38 | 16.50 |
| *Aver.* | *10.34* | *11.82* | *15.65* | *23.62* | *27.04* | *15.66* | *21.90* | *11.22* | *15.80* | *19.08* |

### *Cast Iron Borings*

| | 1914 | 1915 | 1916 | 1917 | 1918 | 1919 | 1920 | 1921 | 1922 | 1923 |
|---|---|---|---|---|---|---|---|---|---|---|
| Jan.... | $7.80 | $8.19 | $10.75 | $11.81 | $20.00 | $15.00 | $18.70 | $13.00 | $10.90 | $18.40 |
| Feb.... | 8.94 | 7.94 | 10.69 | 12.25 | 20.00 | 10.37 | 20.25 | 12.00 | 11.06 | 19.50 |
| March.. | 8.44 | 8.06 | 11.05 | 12.10 | 20.00 | 9.75 | 19.50 | 11.45 | 11.94 | 21.13 |
| April... | 7.75 | 8.25 | 10.94 | 14.25 | 18.50 | 10.62 | 18.60 | 9.38 | 13.33 | 21.88 |
| May... | 7.81 | 8.25 | 9.95 | 15.25 | 18.50 | 10.60 | 17.38 | 9.70 | 14.10 | 20.20 |
| June... | 8.19 | 8.44 | 8.95 | 22.25 | 18.50 | 11.19 | 16.75 | 8.38 | 14.63 | 17.88 |
| July.... | 8.25 | 8.70 | 8.31 | 21.25 | 18.90 | 13.20 | 18.00 | 7.63 | 16.00 | 15.20 |
| Aug.... | 8.25 | 9.19 | 7.70 | 19.60 | 19.00 | 15.25 | 19.63 | 8.30 | 15.70 | 13.88 |
| Sept... | 8.25 | 9.40 | 8.12 | 22.00 | 19.00 | 15.38 | 20.20 | 9.00 | 17.00 | 15.63 |
| Oct.... | 8.44 | 9.31 | 8.87 | 20.00 | 19.00 | 17.90 | 19.00 | 10.13 | 18.60 | 13.50 |
| Nov.... | 7.79 | 9.60 | 10.10 | 18.00 | 19.00 | 17.50 | 17.38 | 10.40 | 17.85 | 12.75 |
| Dec.... | 7.95 | 10.50 | 14.00 | 19.25 | 17.50 | 17.75 | 14.00 | 9.25 | 17.50 | 14.88 |
| *Aver.* | *8.15* | *8.83* | *9.95* | *17.38* | *18.99* | *13.71* | *18.28* | *9.88* | *14.89* | *17.07* |

# Metals, Tin Plate and Sheets for Twenty-One Years

### *Lake Copper, at New York, Cents per Pound (1920, 1921, 1922 and 1923 Prices are Electrolytic Copper)*

| | 1903 | 1904 | 1905 | 1906 | 1907 | 1908 | 1909 | 1910 | 1911 | 1912 | 1913 | 1914 | 1915 | 1916 | 1917 | 1918 | 1919 | 1920 | 1921 | 1922 | 1923 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| January .. | 12.13 | 12.62 | 15.18 | 18.78 | 24.41 | 13.90 | 14.56 | 14.00 | 12.81 | 14.50 | 16.98 | 14.85 | 14.02 | 24.39 | 29.73 | 23.50 | 20.48 | 19.27 | 12.95 | 13.55 | 14.52 |
| February | 12.80 | 12.34 | 15.25 | 17.94 | 25.10 | 13.13 | 13.37 | 13.78 | 12.75 | 14.41 | 15.55 | 15.00 | 15.21 | 26.85 | 34.90 | 23.50 | 17.86 | 19.02 | 12.84 | 12.92 | 15.34 |
| March.... | 14.31 | 12.60 | 15.25 | 18.50 | 23.38 | 12.85 | 12.90 | 13.75 | 12.58 | 14.88 | 15.05 | 14.79 | 15.75 | 27.10 | 35.85 | 23.50 | 15.46 | 18.50 | 12.19 | 12.68 | 16.84 |
| April .. | 14.85 | 13.19 | 15.18 | 18.62 | 24.62 | 13.09 | 12.94 | 13.31 | 12.41 | 16.00 | 15.67 | 14.75 | 18.90 | 28.27 | 31.67 | 23.50 | 15.55 | 19.19 | 12.49 | 12.61 | 16.81 |
| May ..... | 14.75 | 13.28 | 15.00 | 18.70 | 24.10 | 12.88 | 13.21 | 13.06 | 12.33 | 16.30 | 15.91 | 14.40 | 21.00 | 28.88 | 31.42 | 23.50 | 16.18 | 19.05 | 12.79 | 13.13 | 15.54 |
| June ..... | 14.56 | 12.74 | 15.00 | 18.69 | 23.94 | 13.00 | 13.50 | 12.88 | 12.71 | 17.53 | 15.42 | 14.12 | 23.38 | 27.82 | 32.46 | 23.50 | 17.95 | 19.00 | 12.88 | 13.62 | 14.74 |
| July...... | 13.73 | 12.62 | 15.03 | 18.47 | 21.95 | 13.00 | 13.34 | 12.66 | 12.78 | 17.54 | 14.78 | 13.70 | 21.98 | 25.84 | 28.78 | 25.80 | 22.07 | 19.00 | 12.46 | 13.71 | 14.39 |
| August .. | 13.35 | 12.50 | 16.07 | 18.65 | 18.94 | 13.71 | 13.56 | 12.93 | 12.75 | 17.73 | 15.86 | 12.85 | 19.33 | 26.95 | 27.24 | 26.00 | 23.16 | 19.00 | 11.70 | 13.74 | 13.87 |
| September | 13.58 | 12.67 | 16.12 | 19.31 | 16.41 | 13.80 | 13.50 | 12.81 | 12.65 | 17.77 | 16.77 | 12.66 | 17.97 | 28.03 | 24.90 | 26.00 | 22.68 | 18.70 | 12.01 | 13.75 | 13.36 |
| October... | 13.42 | 13.09 | 16.62 | 21.81 | 13.80 | 13.81 | 13.19 | 12.84 | 12.53 | 17.80 | 16.85 | 11.73 | 17.89 | 28.48 | 23.50 | 26.00 | 22.13 | 16.56 | 12.67 | 13.06 | 12.58 |
| November | 13.25 | 14.22 | 16.90 | 22.50 | 13.94 | 14.44 | 13.44 | 12.98 | 12.80 | 17.70 | 16.16 | 12.00 | 18.92 | 32.32 | 23.50 | 26.00 | 20.69 | 14.63 | 13.07 | 13.62 | 12.76 |
| December. | 12.30 | 14.87 | 18.75 | 23.06 | 13.48 | 14.53 | 13.80 | 13.00 | 13.84 | 17.69 | 14.88 | 13.35 | 20.24 | 33.38 | 23.50 | 25.40 | 18.90 | 13.63 | 13.56 | 14.00 | 12.88 |
| *Average.* | *13.59* | *13.06* | *15.86* | *19.59* | *20.34* | *13.51* | *13.44* | *13.17* | *12.75* | *16.65* | *15.82* | *13.68* | *18.72* | *28.19* | *28.95* | *24.68* | *19.43* | *17.96* | *12.63* | *13.42* | *14.47* |

### *Spelter, at New York, Cents per Pound*

| | | | | | | | | | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| January .. | 4.82 | 4.95 | 6.17 | 6.48 | 6.90 | 4.54 | 5.15 | 6.26 | 5.55 | 6.52 | 7.15 | 5.29 | 6.50 | 18.19 | 9.94 | 7.88 | 7.38 | 9.62 | 5.83 | 5.06 | 7.28 |
| February . | 5.00 | 4.95 | 6.12 | 6.09 | 7.00 | 4.78 | 4.99 | 5.89 | 5.56 | 6.71 | 6.45 | 5.40 | 8.84 | 20.13 | 10.48 | 7.99 | 6.70 | 9.14 | 5.36 | 4.85 | 7.58 |
| March.... | 5.36 | 5.05 | 6.06 | 5.96 | 6.92 | 4.76 | 4.81 | 5.72 | 5.65 | 6.98 | 6.26 | 5.28 | 9.29 | 18.40 | 10.77 | 7.64 | 6.52 | 8.93 | 5.20 | 5.00 | 8.19 |
| April .. | 5.65 | 5.22 | 5.97 | 6.05 | 6.81 | 4.68 | 4.94 | 5.60 | 5.51 | 6.86 | 5.77 | 5.18 | 11.22 | 18.58 | 9.85 | 7.01 | 6.51 | 8.63 | 5.24 | 5.25 | 7.65 |
| May ..... | 5.75 | 5.14 | 5.55 | 5.95 | 6.51 | 4.60 | 5.12 | 5.20 | 5.50 | 6.86 | 5.47 | 5.06 | 16.14 | 15.86 | 9.46 | 7.32 | 6.46 | 8.08 | 5.28 | 5.45 | 6.99 |
| June ..... | 6.00 | 4.79 | 5.32 | 6.14 | 6.45 | 4.56 | 5.39 | 5.19 | 5.63 | 6.99 | 5.18 | 5.09 | 22.18 | 12.75 | 9.62 | 8.01 | 6.93 | 7.92 | 4.95 | 5.69 | 6.40 |
| July...... | 5.95 | 4.85 | 5.38 | 5.98 | 6.15 | 4.46 | 5.35 | 5.20 | 5.79 | 7.26 | 5.38 | 5.02 | 20.58 | 9.83 | 8.95 | 8.69 | 7.90 | 8.18 | 4.77 | 6.12 | 6.43 |
| August .. | 5.94 | 4.85 | 5.66 | 6.06 | 5.71 | 4.71 | 5.74 | 5.26 | 6.04 | 7.19 | 5.75 | 5.60 | 14.11 | 8.98 | 8.69 | 8.96 | 7.84 | 8.31 | 4.69 | 6.59 | 6.68 |
| September | 6.00 | 5.06 | 5.83 | 6.19 | 5.28 | 4.76 | 5.85 | 5.53 | 6.03 | 7.53 | 5.82 | 5.50 | 14.16 | 8.22 | 8.34 | 9.60 | 7.57 | 7.82 | 4.74 | 6.91 | 6.81 |
| October... | 6.05 | 5.17 | 6.05 | 6.18 | 5.45 | 4.81 | 6.09 | 5.69 | 6.20 | 7.57 | 5.42 | 4.97 | 13.96 | 9.98 | 8.24 | 9.11 | 7.83 | 7.51 | 5.10 | 7.20 | 6.66 |
| November | 5.68 | 5.49 | 6.17 | 6.36 | 5.10 | 5.03 | 6.32 | 5.95 | 6.60 | 7.48 | 5.29 | 5.12 | 17.15 | 11.90 | 7.95 | 8.70 | 8.14 | 6.84 | 5.18 | 7.48 | 6.70 |
| December. | 5.15 | 5.80 | 6.50 | 6.62 | 4.39 | 5.17 | 6.35 | 5.80 | 6.44 | 7.33 | 5.18 | 5.71 | 16.69 | 11.13 | 7.84 | 8.45 | 8.59 | 6.00 | 5.25 | 7.46 | 6.60 |
| *Average.* | *5.21* | *5.11* | *5.90* | *6.17* | *6.06* | *4.74* | *5.51* | *5.61* | *5.88* | *7.11* | *5.76* | *5.27* | *14.24* | *13.66* | *9.18* | *8.28* | *7.36* | *8.08* | *5.13* | *6.09* | *7.00* |

### *Lead, at New York, Cents per Pound*

| | | | | | | | | | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| January .. | 4.10 | 4.39 | 4.58 | 5.86 | 6.30 | 3.73 | 4.19 | 4.70 | 4.50 | 4.41 | 4.35 | 4.11 | 3.74 | 5.93 | 7.69 | 6.87 | 5.56 | 8.67 | 5.00 | 4.70 | 7.85 |
| February . | 4.10 | 4.40 | 4.50 | 5.56 | 6.31 | 3.75 | 4.07 | 4.63 | 4.46 | 4.00 | 4.35 | 4.06 | 3.82 | 6.23 | 9.13 | 7.04 | 5.05 | 8.88 | 4.54 | 4.70 | 8.14 |
| March.... | 4.44 | 4.50 | 4.45 | 5.35 | 6.31 | 3.88 | 4.02 | 4.51 | 4.41 | 4.08 | 4.35 | 3.97 | 4.04 | 7.43 | 9.47 | 7.24 | 5.23 | 9.21 | 4.08 | 4.71 | 8.47 |
| April .. | 4.59 | 4.50 | 4.50 | 5.39 | 6.16 | 4.02 | 4.19 | 4.40 | 4.44 | 4.20 | 4.40 | 3.82 | 4.20 | 7.73 | 9.43 | 6.95 | 5.03 | 8.95 | 4.33 | 5.13 | 8.19 |
| May ..... | 4.37 | 4.48 | 4.50 | 5.90 | 6.02 | 4.26 | 4.32 | 4.37 | 4.40 | 4.20 | 4.37 | 3.90 | 4.25 | 7.45 | 11.00 | 6.88 | 5.05 | 8.55 | 4.99 | 5.51 | 7.39 |
| June ..... | 4.25 | 4.22 | 4.51 | 5.94 | 5.75 | 4.45 | 4.36 | 4.38 | 4.46 | 4.50 | 4.35 | 3.90 | 5.89 | 6.87 | 11.68 | 7.55 | 5.34 | 8.48 | 4.56 | 5.73 | 7.14 |
| July...... | 4.12 | 4.17 | 4.56 | 5.80 | 5.24 | 4.50 | 4.35 | 4.40 | 4.50 | 4.67 | 4.37 | 3.90 | 5.59 | 6.34 | 10.72 | 8.04 | 5.65 | 8.67 | 4.40 | 5.75 | 6.28 |
| August .. | 4.12 | 4.15 | 4.64 | 5.78 | 5.12 | 4.59 | 4.36 | 4.40 | 4.50 | 4.54 | 4.64 | 3.87 | 4.68 | 6.26 | 10.72 | 8.05 | 5.77 | 8.98 | 4.40 | 5.88 | 6.74 |
| September | 4.26 | 4.20 | 4.85 | 5.92 | 4.84 | 4.54 | 4.39 | 4.40 | 4.40 | 5.04 | 4.73 | 3.86 | 4.62 | 6.88 | 8.84 | 8.05 | 6.12 | 8.11 | 4.60 | 6.20 | 7.06 |
| October... | 4.40 | 4.20 | 5.07 | 5.94 | 4.64 | 4.34 | 4.39 | 4.40 | 4.31 | 5.06 | 4.52 | 3.52 | 4.60 | 7.00 | 6.77 | 8.05 | 6.45 | 7.24 | 4.70 | 6.67 | 6.84 |
| November | 4.25 | 4.51 | 5.48 | 5.97 | 4.45 | 4.39 | 4.40 | 4.44 | 4.31 | 4.66 | 4.33 | 3.68 | 5.16 | 7.13 | 6.44 | 8.05 | 6.76 | 6.33 | 4.70 | 7.20 | 6.87 |
| December. | 4.10 | 4.60 | 5.96 | 6.19 | 3.76 | 4.24 | 4.56 | 4.50 | 4.45 | 4.32 | 4.06 | 3.80 | 5.33 | 7.60 | 6.48 | 6.71 | 7.03 | 4.80 | 4.70 | 7.28 | 7.61 |
| *Average.* | *4.27* | *4.36* | *4.80* | *5.80* | *5.41* | *4.22* | *4.30* | *4.46* | *4.44* | *4.47* | *4.40* | *3.87* | *4.66* | *6.90* | *9.03* | *7.46* | *5.76* | *8.07* | *4.58* | *5.79* | *7.39* |

### *Straits Tin, at New York, Cents per Pound*

| | | | | | | | | | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| January .. | 27.76 | 28.75 | 29.18 | 36.36 | 42.14 | 27.43 | 28.19 | 32.61 | 41.20 | 44.58 | 50.34 | 39.12 | 34.13 | 41.76 | 44.10 | 85.13 | 71.50 | 62.74 | 35.94 | 32.03 | 39.16 |
| February . | 29.14 | 27.98 | 29.49 | 36.48 | 42.16 | 28.74 | 28.44 | 32.65 | 43.34 | 43.56 | 48.71 | 39.82 | 37.25 | 42.60 | 51.47 | 85.00 | 72.45 | 59.87 | 32.16 | 30.74 | 41.98 |
| March.... | 30.06 | 26.19 | 29.21 | 36.62 | 41.29 | 30.46 | 28.75 | 32.51 | 41.10 | 42.76 | 46.93 | 38.03 | 48.73 | 50.53 | 58.38 | 85.00 | 72.50 | 61.93 | 28.79 | 29.14 | 48.61 |
| April .. | 29.69 | 27.99 | 30.43 | 38.86 | 40.84 | 31.79 | 29.35 | 32.83 | 42.05 | 43.64 | 49.04 | 36.10 | 47.64 | 51.51 | 55.82 | 88.53 | 72.50 | 62.12 | 30.36 | 30.58 | 45.84 |
| May ..... | 29.26 | 27.76 | 30.04 | 43.08 | 43.01 | 29.84 | 29.07 | 33.05 | 43.32 | 45.98 | 49.06 | 33.21 | 38.79 | 49.14 | 63.21 | 100.00 | 72.50 | 54.99 | 32.50 | 30.92 | 43.11 |
| June ..... | 28.30 | 26.14 | 30.36 | 38.97 | 42.65 | 28.18 | 29.26 | 32.79 | 46.25 | 47.44 | 45.01 | 30.60 | 40.26 | 42.07 | 61.93 | 91.00 | 71.83 | 48.34 | 29.39 | 31.46 | 40.97 |
| July...... | 27.60 | 26.28 | 31.71 | 37.18 | 41.15 | 28.92 | 29.05 | 32.99 | 43.23 | 44.70 | 41.32 | 35.65 | 37.38 | 38.25 | 62.61 | 93.00 | 70.11 | 49.29 | 27.69 | 31.67 | 38.47 |
| August .. | 28.00 | 26.74 | 32.85 | 39.90 | 37.35 | 29.99 | 29.96 | 33.92 | 43.38 | 45.86 | 41.63 | 48.34 | 34.37 | 38.88 | 62.53 | 91.33 | 62.20 | 47.60 | 26.35 | 32.36 | 39.33 |
| September | 27.06 | 27.27 | 32.21 | 40.32 | 37.22 | 28.91 | 30.00 | 35.17 | 39.69 | 49.16 | 42.63 | 31.13 | 33.13 | 38.65 | 61.54 | 80.40 | 59.79 | 44.43 | 26.70 | 32.36 | 41.60 |
| October... | 25.83 | 28.53 | 32.47 | 42.90 | 32.33 | 29.44 | 30.41 | 36.76 | 41.23 | 50.07 | 40.38 | 30.25 | 33.05 | 41.10 | 62.24 | 78.82 | 54.82 | 40.47 | 27.70 | 34.61 | 41.80 |
| November | 25.35 | 29.00 | 33.46 | 42.70 | 30.81 | 30.43 | 30.74 | 37.38 | 43.08 | 49.87 | 39.75 | 33.28 | 39.50 | 44.12 | 74.18 | 73.67 | 54.17 | 36.97 | 28.93 | 36.76 | 44.09 |
| December. | 27.53 | 29.27 | 35.84 | 42.62 | 27.92 | 29.13 | 32.91 | 38.21 | 45.03 | 49.86 | 37.12 | 34.01 | 38.53 | 42.55 | 84.74 | 71.51 | 53.80 | 34.04 | 32.41 | 37.48 | 47.16 |
| *Average.* | *27.97* | *27.66* | *31.44* | *39.67* | *38.24* | *29.44* | *29.68* | *34.24* | *42.74* | *46.46* | *44.33* | *35.80* | *38.56* | *43.43* | *61.90* | *85.28* | *65.68* | *50.23* | *29.91* | *32.51* | *42.68* |

### *Tin Plate, at Pittsburgh, Dollars per Box*

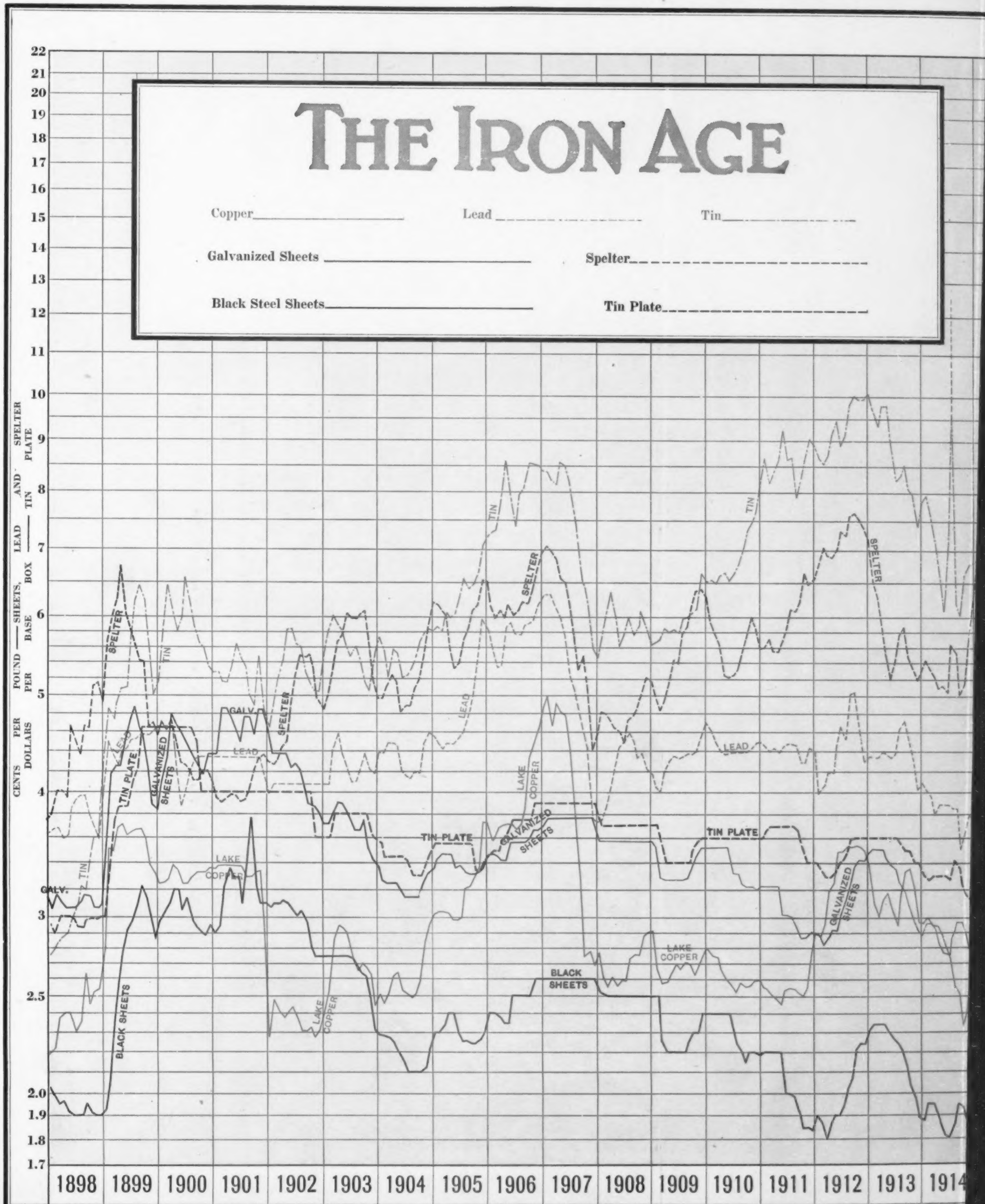
| | | | | | | | | | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| January .. | $3.80 | $3.56 | $3.55 | $3.47 | $3.90 | $3.74 | 3.70 | $3.60 | $3.60 | $3.40 | $3.60 | $3.32 | $3.10 | $3.75 | $7.00 | $7.75 | $7.35 | $7.00 | $7.00 | $4.75 | $4.75 |
| February . | 3.60 | 3.45 | 3.55 | 3.50 | 3.90 | 3.70 | 3.70 | 3.60 | 3.67 | 3.35 | 3.60 | 3.29 | 3.10 | 3.96 | 7.38 | 7.75 | 7.35 | 7.00 | 7.00 | 4.71 | 4.80 |
| March.... | 3.80 | 3.45 | 3.55 | 3.50 | 3.90 | 3.70 | 3.53 | 3.60 | 3.70 | 3.30 | 3.60 | 3.30 | 3.25 | 4.19 | 8.00 | 7.75 | 7.26 | 7.00 | 7.00 | 4.60 | 5.23 |
| April ..... | 3.80 | 3.45 | 3.55 | 3.57 | 3.90 | 3.70 | 3.40 | 3.60 | 3.70 | 3.30 | 3.60 | 3.30 | 3.25 | 4.50 | 8.00 | 7.75 | 7.00 | 7.00 | 6.44 | 4.75 | 6.00 |
| May ..... | 3.80 | 3.45 | 3.55 | 3.66 | 3.90 | 3.70 | 3.40 | 3.60 | 3.70 | 3.33 | 3.60 | 3.30 | 3.15 | 5.30 | 8.40 | 7.75 | 7.00 | 7.00 | 6.25 | 4.75 | 5.70 |
| June ..... | 3.80 | 3.45 | 3.55 | 3.75 | 3.90 | 3.70 | 3.40 | 3.60 | 3.70 | 3.40 | 3.60 | 3.30 | 3.11 | 5.81 | 10.50 | 7.75 | 7.00 | 7.00 | 6.25 | 4.75 | 5.50 |
| July...... | 3.80 | 3.41 | 3.55 | 3.75 | 3.90 | 3.70 | 3.40 | 3.60 | 3.70 | 3.43 | 3.60 | 3.27 | 3.10 | 6.00 | 12.00 | 7.75 | 7.00 | 7.50 | 5.69 | 4.75 | 5.50 |
| August ... | 3.80 | 3.30 | 3.55 | 3.75 | 3.90 | 3.70 | 3.40 | 3.60 | 3.70 | 3.50 | 3.55 | 3.41 | 3.10 | 5.95 | 11.40 | 7.75 | 7.00 | 9.00 | 5.25 | 4.75 | 5.50 |
| September | 3.80 | 3.30 | 3.55 | 3.75 | 3.90 | 3.70 | 3.40 | 3.60 | 3.67 | 3.58 | 3.50 | 3.35 | 3.15 | 5.75 | 12.00 | 7.75 | 7.00 | 9.00 | 5.25 | 4.75 | 5.50 |
| October... | 3.80 | 3.30 | 3.34 | 3.75 | 3.90 | 3.70 | 3.50 | 3.60 | 3.52 | 3.60 | 3.50 | 3.24 | 3.15 | 5.81 | ..... | 7.75 | 7.00 | 8.33 | 5.13 | 4.75 | 5.50 |
| November | 3.65 | 3.39 | 3.34 | 3.90 | 3.90 | 3.70 | 3.56 | 3.60 | 3.40 | 3.60 | 3.40 | 3.15 | 3.28 | 5.97 | 7.75 | 7.75 | 7.00 | 7.50 | 4.75 | 4.75 | 5.50 |
| December. | 3.60 | 3.47 | 3.40 | 3.90 | 3.90 | 3.70 | 3.60 | 3.60 | 3.40 | 3.60 | 3.40 | 3.13 | 3.52 | 6.63 | 7.75 | 7.55 | 7.00 | 7.00 | 4.73 | 4.75 | 5.50 |
| *Average.* | *3.74* | *3.42* | *3.50* | *3.09* | *3.90* | *3.70* | *3.50* | *3.60* | *3.62* | *3.45* | *3.55* | *3.28* | *3.19* | *5.30* | *9.11* | *7.73* | *7.08* | *7.53* | *5.90* | *4.73* | *5.42* |

### *No. 28 Black Sheets, at Pittsburgh, Cents per Pound*

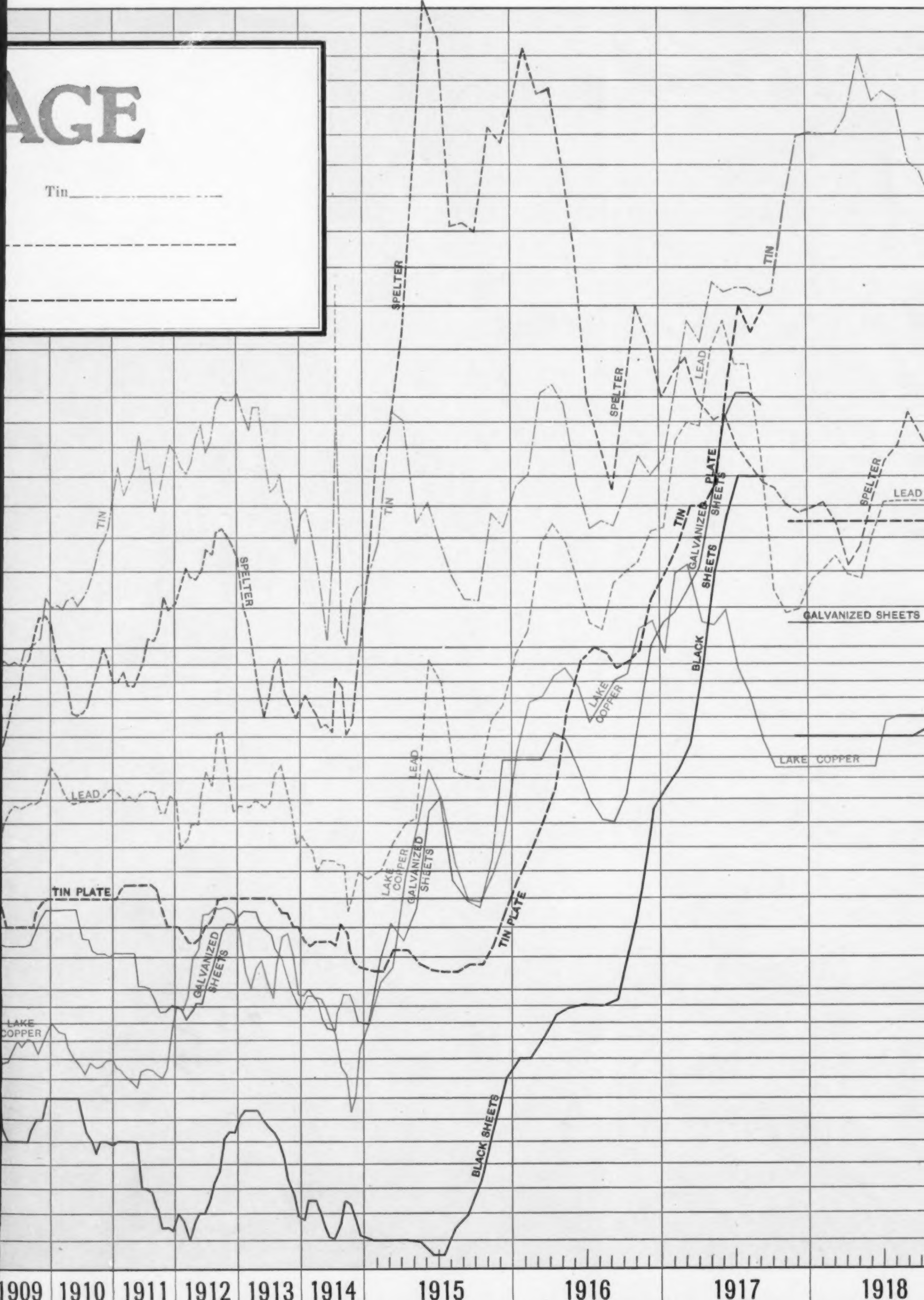
| | | | | | | | | | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| January... | 2.75 | 2.20 | 2.30 | 2.40 | 2.60 | 2.52 | 2.50 | 2.40 | 2.20 | 1.90 | 2.31 | 1.87 | 1.80 | 2.60 | 4.50 | 5.00 | 4.70 | 4.48 | 4.35 | 3.00 | 3.35 |
| February.. | 2.75 | 2.28 | 2.30 | 2.40 | 2.60 | 2.50 | 2.50 | 2.40 | 2.20 | 1.87 | 2.35 | 1.95 | 1.80 | 2.60 | 4.69 | 5.00 | 4.70 | 5.00 | 4.21 | 3.00 | 3.46 |
| March.... | 2.75 | 2.27 | 2.34 | 2.38 | 2.60 | 2.50 | 2.25 | 2.40 | 2.20 | 1.80 | 2.35 | 1.95 | 1.80 | 2.71 | 4.94 | 5.00 | 4.61 | 5.50 | 3.88 | 3.00 | 3.71 |
| April...... | 2.75 | 2.25 | 2.40 | 2.35 | 2.60 | 2.50 | 2.20 | 2.40 | 2.20 | 1.86 | 2.35 | 1.91 | 1.80 | 2.85 | 5.75 | 5.00 | 4.35 | 5.50 | 3.88 | 3.11 | 4.00 |
| May...... | 2.75 | 2.20 | 2.40 | 2.35 | 2.60 | 2.50 | 2.20 | 2.40 | 2.20 | 1.90 | 2.30 | 1.85 | 1.79 | 2.89 | 7.00 | 5.00 | 4.35 | 5.50 | 4.00 | 3.15 | 3.88 |
| June...... | 2.75 | 2.16 | 2.30 | 2.50 | 2.60 | 2.50 | 2.20 | 2.40 | 2.00 | 1.90 | 2.27 | 1.81 | 1.75 | 2.90 | 7.88 | 5.00 | 4.35 | 5.50 | 3.80 | 3.15 | 3.85 |
| July...... | 2.74 | 2.10 | 2.26 | 2.50 | 2.60 | 2.50 | 2.20 | 2.24 | 2.00 | 1.95 | 2.25 | 1.80 | 1.75 | 2.90 | 8.50 | 5.00 | 4.35 | 6.75 | 3.31 | 3.16 | 3.81 |
| August.... | 2.70 | 2.10 | 2.26 | 2.50 | 2.60 | 2.50 | 2.20 | 2.21 | 1.99 | 2.02 | 2.21 | 1.86 | 1.85 | 2.90 | 8.50 | 5.00 | 4.35 | 7.50 | 2.90 | 3.23 | 3.75 |
| September. | 2.65 | 2.10 | 2.25 | 2.50 | 2.60 | 2.50 | 2.26 | 2.15 | 1.91 | 2.07 | 2.14 | 1.95 | 1.90 | 2.93 | 8.50 | 5.00 | 4.35 | 7.38 | 2.81 | 3.35 | 3.75 |
| October... | 2.62 | 2.10 | 2.25 | 2.50 | 2.60 | 2.50 | 2.30 | 2.20 | 1.85 | 2.21 | 2.04 | 1.94 | 2.03 | 3.23 | ..... | 5.05 | 4.35 | 6.69 | 3.00 | 3.47 | 3.75 |
| November. | 2.49 | 2.13 | 2.27 | 2.60 | 2.60 | 2.50 | 2.30 | 2.20 | 1.85 | 2.25 | 1.97 | 1.87 | 2.25 | 3.65 | 5.00 | 5.00 | 4.35 | 5.77 | 2.86 | 3.35 | 3.75 |
| December. | 2.32 | 2.22 | 2.30 | 2.60 | 2.60 | 2.50 | 2.40 | 2.19 | 1.84 | 2.25 | 1.89 | 1.82 | 2.50 | 4.31 | 5.00 | 4.85 | 4.35 | 4.35 | 3.00 | 3.35 | 3.75 |
| *Average..* | *2.67* | *2.18* | *2.30* | *2.47* | *2.60* | *2.50* | *2.29* | *2.30* | *2.04* | *2.00* | *2.20* | *1.88* | *1.92* | *3.04* | *6.39* | *4.99* | *4.43* | *5.83* | *3.50* | *3.19* | *3.73* |

### *No. 28 Galvanized Sheets, at Pittsburgh, Cents per Pound*

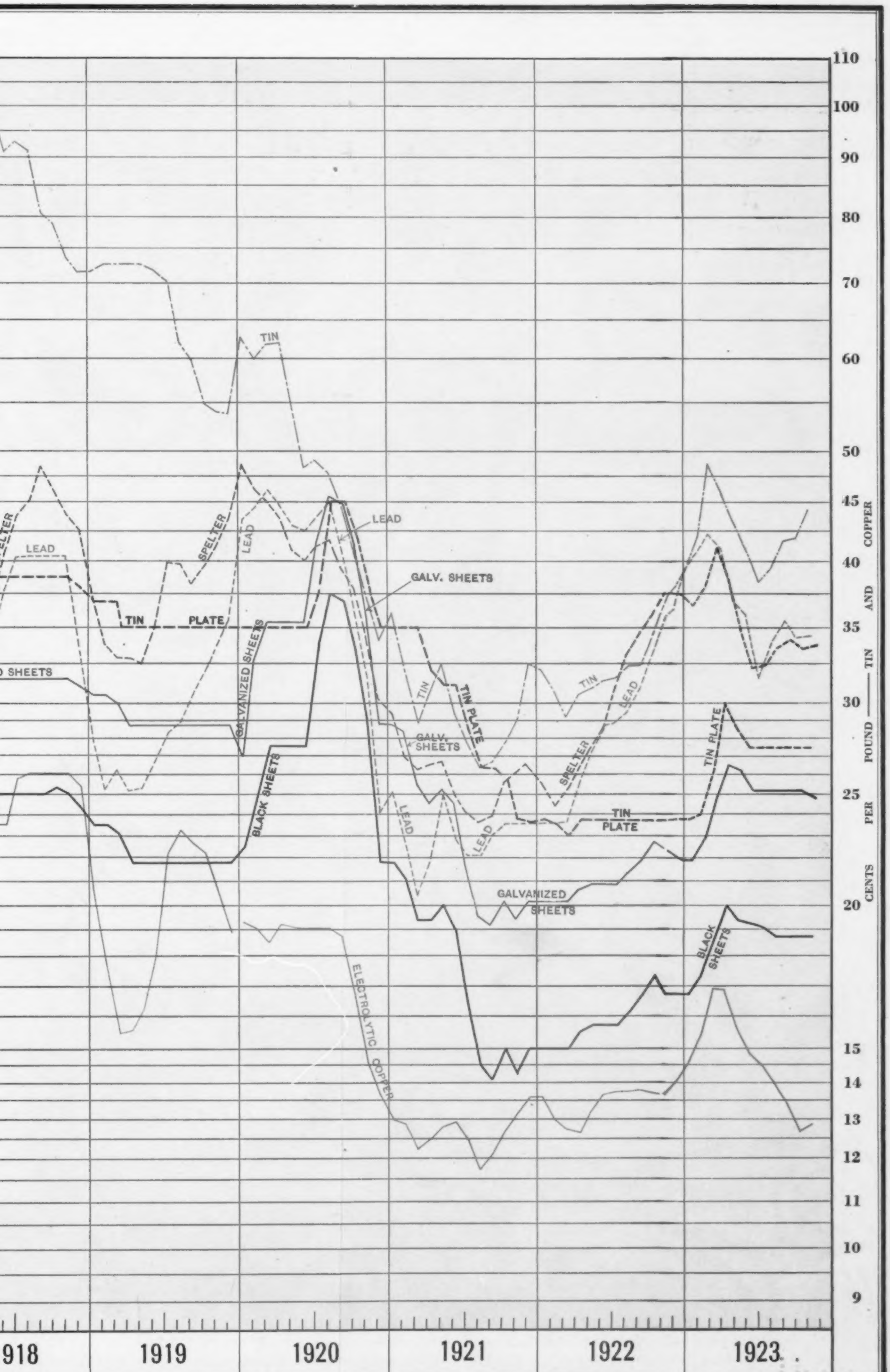
| | 1903 | 1904 | 1905 | 1906 | 1907 | 1908 | 1909 | 1910 | 1911 | 1912 | 1913 | 1914 | 1915 | 1916 | 1917 | 1918 | 1919 | 1920 | 1921 | 1922 | 1923 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| January... | 3.70 | 3.36 | 3.35 | 3.45 | 3.67 | 3.59 | 3.55 | 3.50 | 3.20 | 2.90 | 3.46 | 2.87 | 2.79 | 4.75 | 6.25 | 6.25 | 6.05 | 5.33 | 5.70 | 4.00 | 4.35 |
| February.. | 3.70 | 3.25 | 3.40 | 3.45 | 3.75 | 3.55 | 3.51 | 3.50 | 3.20 | 2.87 | 3.50 | 2.95 | 3.16 | 4.75 | 6.38 | 6.25 | 6.05 | 6.50 | 5.56 | 4.00 | 4.54 |
| March.... | 3.78 | 3.23 | 3.45 | 3.43 | 3.75 | 3.55 | 3.26 | 3.50 | 3.20 | 2.80 | 3.50 | 2.95 | 3.40 | 4.75 | 6.69 | 6.25 | 5.96 | 7.00 | 5.05 | 4.00 | 4.93 |
| April...... | 3.89 | 3.23 | 3.45 | 3.40 | 3.75 | 3.55 | 3.25 | 3.50 | 3.20 | 2.86 | 3.50 | 2.91 | 3.29 | 5.00 | 7.00 | 6.25 | 5.70 | 7.00 | 4.88 | 4.11 | 5.25 |
| May...... | 3.88 | 3.23 | 3.45 | 3.40 | 3.75 | 3.55 | 3.25 | 3.50 | 3.20 | 2.90 | 3.42 | 2.80 | 3.50 | 4.94 | 8.20 | 6.25 | 5.70 | 7.00 | 5.00 | 4.15 | 5.20 |
| June...... | 3.81 | 3.18 | 3.35 | 3.55 | 3.75 | 3.55 | 3.25 | 3.50 | 3.00 | 2.90 | 3.38 | 2.75 | 4.28 | 4.69 | 9.50 | 6.25 | 5.70 | 7.00 | 4.88 | 4.15 | 5.00 |
| July...... | 3.73 | 3.14 | 3.36 | 3.55 | 3.75 | 3.55 | 3.25 | 3.39 | 3.00 | 3.00 | 3.33 | 2.75 | 4.40 | 4.38 | 10.00 | 6.25 | 5.70 | 8.25 | 4.31 | 4.15 | 5.00 |
| August.... | 3.66 | 3.14 | 3.32 | 3.55 | 3.75 | 3.55 | 3.25 | 3.30 | 2.99 | 3.12 | 3.24 | 2.85 | 3.71 | 4.21 | 10.00 | 6.25 | 5.70 | 9.00 | 3.90 | 4.23 | 5.00 |
| September. | 3.66 | 3.14 | 3.30 | 3.55 | 3.75 | 3.55 | 3.28 | 3.21 | 2.93 | 3.21 | 3.16 | 2.95 | 3.56 | 4.18 | 9.75 | 6.25 | 5.70 | 8.88 | 3.81 | 4.35 | 5.00 |
| October... | 3.73 | 3.14 | 3.30 | 3.58 | 3.75 | 3.55 | 3.35 | 3.20 | 2.85 | 3.36 | 3.08 | 2.95 | 3.50 | 4.41 | .... | 6.25 | 5.70 | 8.18 | 4.00 | 4.50 | 5.00 |
| November. | 3.51 | 3.23 | 3.32 | 3.65 | 3.75 | 3.55 | 3.43 | 3.20 | 2.85 | 3.40 | 2.98 | 2.88 | 3.89 | 5.18 | 6.25 | 6.25 | 5.70 | 7.04 | 3.86 | 4.43 | 4.93 |
| December. | 3.40 | 3.31 | 3.35 | 3.65 | 3.75 | 3.55 | 3.50 | 3.19 | 2.89 | 3.40 | 2.90 | 2.78 | 4.75 | 6.00 | 6.25 | 6.15 | 5.70 | 5.70 | 4.00 | 4.35 | 4.89 |
| *Average..* | *3.70* | *3.22* | *3.37* | *3.52* | *3.74* | *3.55* | *3.34* | *3.37* | *3.04* | *3.06* | *3.29* | *2.87* | *3.69* | *4.77* | *7.84* | *6.24* | *5.78* | *7.24* | *4.58* | *4.20* | *4.92* |




**26 Years of Fluctuations in Carload Prices of Copper, Lead, Tin and S**




s of Copper, Lead, Tin and Spelter in New York and Tin Plate and No.




No. 28 Black and Galvanized Sheets in Pittsburgh

(*Continued from page 78*)

atures were approached to within 100 deg. C. and the time for the heat cut down from six or seven hours' duration to two hours or less. It was found by experiment that the duration of the heat was greatly reduced by increasing the hydrogen content of the gas. While based on the conditions applying in German steel plants, the author's conclusions are interesting, which are briefly: Coke the coal and obtain coke oven gas and coke. Convert the coke partly into producer gas and partly into water gas, using the mixture of the three gases. This would result in an absence of heavy hydrocarbons and the presence of little water vapor, giving a gas easily cleaned and compressed.

*Hoesch Process:* The Hoesch process of open-hearth practice has long been familiar to metallurgists. It was developed at Hoesch, Germany. While frequently described in metallurgical textbooks, it has lately been the subject of a report to the steel workers' committee of the German Ironmasters Association.[12] While not at this time of great commercial importance in this country because we are not primarily concerned with the smelting of high phosphorus iron in the open-hearth, nevertheless the metallurgy is interesting and timely from the standpoint of utilization of the basic slag formed, recently discussed in a Bureau of Soils contribution.[13]

As a first step, iron ore and mill scale are charged and heated; the molten pig then goes in. After reactions have carried the bulk of the oxidized phosphorus to the slag, the whole heat is tapped as cleanly as possible to the ladle and the slag separated, after which the metal is returned to the furnace for the second stage. The first stage metal will average 1.7 per cent carbon, 0.3 per cent phosphorus and 0.30 per cent manganese. After making the first tap, scrap, ore and lime are charged and the first stage metal is recharged and the heat worked; 0.7 to 1.0 per cent manganese is desired because of the necessity of a balance between the proper deoxidation of the heat and the danger of re-phosphorization of the bath. Low carbon steels are readily produced but danger of re-phosphorization is greater with higher carbon heats.

The hot metal may be up to 3 per cent phosphorus but preferably not over 2 per cent. With the former figure the furnace atmosphere must be more oxidizing, in which case producer gas would be a more satisfactory fuel than the coke oven gas used at the Hoesch plant. It has not been found possible to overcome the deficiency in the oxidizing action of the gases by the use of ore with 2.4 per cent phosphorus pig and 3 per cent phosphorus ore (Kiruna). The phosphorus is brought down to 0.45 per cent in the first stage. This elimination may be exceeded, it is hoped, by a furnace with a greater area of bath surface. The present ratio is 5.55 sq. ft. of surface per gross ton of steel made. Manganese in the pig need not exceed 1 per cent and may be just high enough to take care of the sulphur in the blast furnace. Carbon should be maintained not less than 3.3 per cent, especially with high phosphorus, since carbon must exceed the phosphorus throughout the heat. Silicon should not exceed 0.4 per cent for best working because of the amount of slag made.

With a well balanced practice about 80 per cent of the charge may be pig iron, although this question will depend on the balance between economic conditions, such as the price of scrap and metallurgical conditions, such as the quantity of phosphorus eliminated in the first stage slags, which are the valuable ones, having 80 to 90 per cent citric acid solubility. If the first stage heat is tapped too hard the phosphorus in the metal will be too high, although this permits a higher addition of scrap in the second stage. If this scrap addition be too high, remelting of the whole heat will be necessary, because of excessive chilling. With a soft first stage heat the bath will react well in the second stage.

## Iron and Steel

The question of chemical specifications for iron and steel was again thrashed over during the year, but there was no definite decision reached. Doctor Burgess has expressed the opinion that it appeared to be unnecessary to specify chemical composition where there were definite physical specifications and that such practice might make steel more costly than would otherwise be the case.

*Galvanized Malleable Iron:* Information[14] has been contributed on the cause of brittleness in hot galvanized malleable cast iron. Irons high in phosphorus and silicon are embrittled by the quench given after the hot galvanized dip. The results of investigation show the brittleness to be due to intergranular weaknesses and that it may be overcome or minimized by a slower cool from the dip.

Scrap tin cans can be made into gray iron in the electric furnace. In melting in the electric furnace the tin is not volatilized but the lead and zinc are lost.

### Cast Iron

The McConway process of centrifugal casting is in successful operation. Long life molds for the foundry have a metal body which is given a refractory coating of bauxite, fireclay, magnesia, etc., mixed with a numeral binder. This is put on in layers, dried and smoked with an acetylene flame.

*Heat Treatment:* Considerable research work has been done in special treatments of one type or another to improve the physical properties of cast iron. Some of the work has not yet been published, but one interesting contribution to the technology has been known as the production of so-called "pearlitic" cast iron. This has been brought about on a foundry production scale in Germany. It is known that the use of the usual casting mixtures and methods results in a gray iron of low ductility, due in part to the relatively large masses of graphite occurring in the structure of the metal. By nicely balancing the silicon content of the gray iron and casting in a highly pre-heated sand mold, the rate of cooling and the precipitation of graphite is such that the resulting structure consists metallographically of a pearlitic ground mass, while the graphite particles are small and therefore of much lessened influence in causing brittleness. The resultant material partakes more of the physical nature of malleable cast iron. This development has been referred to as of great interest in the foundry industry but so far not much data have been available. It would seem that the commercial handicap pertaining to the heating and handling of the molds would be considerable.

The mechanical properties of cast iron have been greatly improved where the question of machinability is not the most important item. Tests of a large number of heats have shown an average of 50,000 lb. per sq. in. tensile strength and a 1 per cent elongation with a Brinell number of 290. These results have been attained directly through the instrumentality of carefully planned research work. Advances in heat treatment have resulted in improved machinability and at the same time increase of tensile properties has even imparted some torsional ductility.

*Desulphurization:* In 1890 the average sulphur in cast iron was 0.05 per cent; it is now 0.14 per cent to 0.18 per cent, and the problem of combating this high sulphur is immediate. A method has been described for desulphurizing molten cast iron. The procedure is to first melt soda ash to free it from air and impart the property of melting quickly when subsequently used.

This caked material is then thrown on the clean surface of the molten iron. It is necessary to have the surface free from slag both because of its interfering effect and because of the necessity for avoiding silica. The soda ash reduces the sulphur rapidly, eliminating as much as 32 per cent in some tests. The slag is then scabbed with lime and removed. The process takes about 2¼ to 4 min. to complete the reaction. The sulphur is removed uniformly throughout the mass of molten cast iron treated.

The relative cost of cupola and electric furnace melting is a matter of controversy. It has been stated that the electric furnace will not compete with the cupola in making castings as far as cost goes. This is disputed by the statement that running conditions and also the increase in quality may make the relative costs more nearly equal. Because of the contribution of electrical furnace melting to quality, this factor must be brought into the calculation.

*Electrolytic Galvanizing:* What is claimed to be a successful practice of electrolytic galvanizing of iron sheets has recently been described. It is claimed that the product is able to compete in quality with hot galvanized sheets. The coating is said to be dense and firmly adherent and to lack the porous nature of most electrolytically deposited metals, since it is able to withstand bending and twisting and it showed better corrosion test results with a lighter weight of zinc per square inch of area. One of the advantages claimed for the process is the saving in zinc through the elimination of the heavy losses in "drossing" caused by the formation of the insoluble iron-zinc alloy.

*Alloy Steel for Switches:* Some cast chrome-nickel steels[15] with about 1 per cent chromium and about 3 per cent nickel have been used very successfully in street railroad crossings, being resistant to wear and deformation. Machinability, excellent physical properties and good welding ability were all in favor of the steel casting composition described. The heat treatment consisted of air quench at 1725 deg. Fahr. and an anneal at just below the critical range.

The work of the Bureau of Mines Station at Ithaca has further developed the excellent properties of molybdenum steels. It noted that the effect of molybdenum is to split the critical points and give a hardening effect which is especially useful when molybdenum is used in connection with certain other steel alloying elements.

### Fatigue of Steel

*Shock Resistance of Steels:* As a result of French experiments some interesting data have been submitted on the effect of cold work on the resistance of steel to repeated shock. A steel[16] with the 0.12 per cent carbon, 0.61 per cent Mn and 0.13 per cent silicon and low sulphur and phosphorus was used in the tests. Bars were annealed and given various reductions to produce samples which had received increasing amounts of cold deformation. While difficult to evaluate, the results are roughly indicative of the effect of cold work on steel. By drawing from a diameter of 17½ to 15 mm., the tensile strength was increased 50 per cent, the elastic limit was increased 90 per cent and elongation was decreased 76 per cent. The compressive strength decreased 16 per cent while resistance to repeated shock was increased 110 per cent. Along this same line, the Bureau of Standards recently did some work on copper, showing that the hardness increased with cold work up to a certain critical value, after which further deformation materially softened the material.

Work[17] done at the Watertown Arsenal on the effect of heat treatment on the shock resistance of various steels has been quite extensive. It is shown by numerous curves that the shock resistance of most steels rises as the temperature of impact test is increased up to a certain point, after which impact resistance falls away rapidly.

The tests were made by heating the various specimens to a given temperature and shock testing them while at that temperature. It has long been known that certain steels if quenched from the drawing temperature would have a given impact resistance, while if slowly cooled from the same drawing temperature, the steel would be of much lower impact value. This quality has been variously called Krupp-Krankheit, temper brittleness, etc. The present tests have shown that the release from this brittleness obtained by the increased rate of cooling from the draw does not justify the broad statement that such rapid cooling always prevents brittleness, but rather that the statement must be qualified by the temperature at which the shock test is made. The Watertown results presented by Langenberg show more favorable results for chromium bearing steels than for the other compositions tested. As regards the effect of previous heat treatment, double quenching seems to be beneficial, but this was not true in the case of some case hardened materials where the second quenching has partly reduced the shock-resistance quality of the core. From this it is argued that case hardening stock should be under 0.20 per cent carbon in order to obtain the most satisfactory results on hardened material which is to be refined by double quenching.

### Steel at High Temperatures

The Bureau of Standards has lately published the results of tensile tests of steels at high temperatures. The specific effects of a number of alloying elements were investigated. Steels containing one or more of the following metals were tested at temperatures up to 800 deg. C.: Nickel, chromium, vanadium, tungsten, cobalt and uranium. The effect on the tensile strength of steel of increasing the temperature of the test tensile is to slightly increase the value, after which there is a marked reduction in tensile strength. If the tensile strength is plotted against temperatures as abscissae, after having passed the peak of the strength curve there is a rapid falling off with increasing temperature, so that the drop on the curve above 300 or 400 deg. C. is very sharp and abrupt. Any element, therefore, which will push the knee of the curve to the right will be of considerable use in those forms of construction which require high strength at high temperatures. Cobalt was found to be useful in this respect, but the outstanding element was found to be chromium.

*Zirconium:* The effect of zirconium additions to steel have been announced[18] recently as a result of considerable research work. The deoxidizing and scavenging action of zirconium has been particularly marked in the results obtained. Hot shortness due to the presence of sulphur has been eliminated and there is a possibility that the zirconium treatment may have a pronounced effect on the utilization of higher sulphur material, provided other factors permit. Tellurium has been introduced into steel, but no outstanding results are apparent other than the possibility of an increase in machining properties such as is imparted by manganese sulphide in screw stock.

### Miscellaneous Developments

*Refractories:* The search for more satisfactory refractories is being continued very actively. The research work on heat-treatments applied to silica refractories has been directed toward the development and control of the phase changes in silica. A novel refractory consisting of carbonized clay was described before the West of Scotland Iron and Steel Institute. Refractory materials are made into the form of brick and then subjected at high temperatures to action of

hydrocarbon gases. These crack and deposit carbon in the minutest pores of the refractory. The resulting complex then takes on a high degree of hardness, compressive strength and infusibility. This is due to the fact that the cell spaces of the refractories are filled with a carbon deposit so that "squirting" under load is minimized. The development may have an interesting future.

*Bichromates and Rust Resistance:* The use of bichromate to impart passivity to iron and steel has been known for a great many years. It now appears that chromium salts are susceptible of much more extended usefulness along these lines, particularly in the preservation of freshly polished surfaces. Its presence in concrete mixtures and in paints has lately been discussed. Saw-dust, blotting paper or other inert absorbent material may be soaked with 70 per cent of water, 30 per cent glycerine and 2 per cent potassium chromate and 2 per cent soda. The glycerine acts to keep the material moist, which is an important factor. Bright metal parts may be preserved indefinitely without rusting or other deterioration if packed in the mixture.

*Oxygen in Metallurgy:* The Bureau of Mines has been actively at work on the theoretical advantages possible from the use of oxygen in metallurgical processes. The work so far has consisted of a survey of the field. Some of the advantages claimed are that it will be possible to manufacture high phosphorus slag by the basic-Bessemer process, the use of cheaper fuel, shortening of the time required at present in many processes and improving the quality of the product in some cases. The whole subject at present is dependent on the availability of very cheap oxygen, which may still be a question of considerable conjecture.

### High-Speed Steel

*Cause of Hardness:* Bain and Jeffries have discussed[19] a theory to account for the red hardness of high-speed steel, i.e., why it is that high-speed steel retains its hardness at a temperature well above that at which ordinary steels will lose their hardness. The authors have collated numerous data on the physico-chemical changes which take place in the high-speed steels when variously heat treated. These changes embrace those in metallographic structure, magnetic properties, changes in dimension, hardness, etc. Crystal analysis by X-ray has furnished data which are also critically considered.

The paper is not easily abstracted but the following conclusions have been reached: Even though heated to incipient fusion, high-speed steel contains more carbide than will completely dissolve in the austenite. The austenite dissolves at high temperatures some of the carbide which is present in the residual matrix as separate elements. After quenching, the steel consists of some undissolved carbide, some martensite and the balance austenite, both of which have the chromium and vanadium, etc., atomically dispersed. The only change possible in the martensite at room temperature is the association of carbon and iron atoms to form cementite. At higher temperatures the chromium and vanadium atoms will form carbides and these grow by coalescence. Within the grain growth temperature range, the growth is obstructed by the interference of the carbides. The combination of restricted grain growth and carbide particles in critical dispersion, causes the red hardness. Heating above the red hardness temperature, ferrite grain growth and growth of the carbide particles causes softening, which is similar in effect to the softening of ordinary steels. Summing up the views of the authors, the distinctive phenomena are the same as occur in plain carbon steels, only at much higher temperatures, because of the molecular sluggishness imparted by the alloying atoms—particularly the tungsten. The hardness of martensite (excessively fine ferrite) is caused by small grains and the "keying" action of carbides in a state of critical dispersion.

*X-Ray and Steel:* St. John has showed[20] in a few concise statements the mechanism of the X-ray examination of metals and has shown its possibilities in the steel industry. It would seem that the X-ray is now where the metallurgical microscope was several decades ago. The pioneer work done in this country for the microscope by Howe, and particularly by Sauveur, is now being done in a similar way by the experts with the new tool—Hull, Bain, Lester and St. John.

### Research and the Future

The greatest promise for the future is in the constantly increasing realization of the value of research work. Among the foundrymen particularly, has the dollars and cents value of research been forcibly illustrated. Cooperative work on sands and foundry methods, market factors and even costs have been of mutual benefit. Throughout the chemical and steel industries more and more interest has arisen for research. Depletion and increasing cost of fuel supply and even the very apparent changes in actual chemical compositions of certain natural resources are making essential the closer study of ways and means to obtain results with less expenditure of labor and material. Too many of the leaders in industry are thoroughly sold to the importance of systematic research to justify any fear for its ultimate fate in this country. Well may we wish it success!

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The most striking aspect of the movement for industrial standardization is the development of standardization on a national scale. More than 150 undertakings now have official status before the American Engineering Standards Committee, the national clearing house for standardization. Fifty standards have received final approval by the committee, 22 of which were approved during 1923. The importance of the broadly democratic methods followed in this clearing house work is receiving increasingly widespread recognition.

# Ferroalloy Developments in the Past Year

## Market Conditions and Results of Metallurgical Research —The Growing Field of Special Alloys

BY ROBERT J. ANDERSON*

THE general recovery in the metallurgical ferroalloy and ore industry that started in 1922 after the post-war slump in the steel trade has been continued through 1923, and some branches of the industry have been operated at about their physical limits. Production of most ferroalloys and steel-making metals was sharply increased in 1923 over 1922 both in the United States and foreign countries, and the import-and-export trade was larger. Mining of ores for ferroalloy manufacture was resumed in the principal producing countries after partial or total shut down in 1921 and 1922, and the production of chromite in Rhodesia is on a larger scale than ever. Manganese-ore mining in the United States has been resumed on a moderate scale, but the tungsten-ore mining industry is still dormant.

Production and consumption of ferroalloys has increased owing to the marked increase in steel output and the general industrial activity of the past year. Steel ingot output in the United States in 1923 was at the rate of 43,600,000 gross tons, or 85 per cent of rated capacity, as compared with 33,500,000 tons in 1922, or about 71 per cent of rated capacity. It should be pointed out, however, that the increase in production of ferroalloys was more marked, since part of the alloy steel output of 1922 was made from accumulated stocks of ferroalloys, and these stocks are now practically exhausted. Pig iron production in 1923 was markedly increased over 1922, as was the production of all grades of blast furnace ferroalloys. Production of motor cars and trucks was greatly increased in 1923 over 1922, preliminary estimates giving 4,000,000 cars and trucks for 1923, as against 2,527,000 in 1922. Consequently, there was increased consumption of structural alloy steels and of high-speed and special tool steels for machining and also of certain of the ferroalloys. The first half of 1923, in the ferroalloy industry, was generally marked by excessive production stimulated by increasing prices, followed by a decline in prices in the summer and a gradual recovery in the early fall with curtailment of output. Demand for most alloys was steady all year. The Ruhr shut down was a direct stimulus to England and to the continental steel and ferroalloy makers with the exception of the French. Italian ferroalloy production was especially stimulated.

### Markets and the Trade Situation

As indicated, the markets for most ferroalloys and ores were much better in 1923 than in 1922, and there were substantial increases in imports, exports, and domestic shipments. Japan is developing in ferroalloy manufacture, and there are prospects of steel and alloy industries for Brazil and the west coast of South America. The German industry remains poor because, owing to rising costs, it is possible for German consumers to buy alloys and steel products cheaper abroad than to make them at home. In Russia, the manganese ore industry is apparently gradually getting on a better basis, and the general iron and steel industry there is being improved as communistic methods are being abandoned. The domestic import duties on manganese ore have had marked effect on prices in all markets, and there was a scarcity of manganese ore at times during the year in England. France, Germany, and England all competed keenly for shipments of Brazilian and Indian manganese ore. Demand for spiegeleisen was good in the United States, and many inquiries came from those hitherto using ferromanganese. England suffered a coal shortage last year, but neither output nor price of ferromanganese were affected. The market for 50 per cent electric furnace ferrosilicon was strong, and there was scarcity at times.

Referring to the tariff: Import duties on ores and alloys brought into the United States have affected most markets, but these duties have not served markedly to stimulate domestic production of so-called war minerals. In March, decision was made by the Treasury Department that ferrosilicon was being dumped into the United States from the Province of Ontario, and action was taken under the anti-dumping section of the emergency tariff law; the law provides for a special dumping duty to equal the difference between the purchase price and the foreign market value or the cost of production. Treasury regulations were also issued permitting drawbacks in steel products made from imported ferromanganese and spiegeleisen produced from imported manganese ore. The customary drawback of 99 per cent of the duties paid is allowed on steel products exported when made from imported materials. The total British exports of ferroalloys in the first half of 1923 were 109,983 tons and imports were 12,034 tons; German imports were 6127 tons for January to May inclusive and exports were 8790 tons.

### Technical Progress

A large amount of experimental work has been going on in the development of methods for the production of better grades of ferroalloys and in the development of special alloy steels. As pointed out in this review last year, rapid advancement is being made in the use of special alloy steels, and ferroalloys have been the most important factor in this advance, together with improved methods of manufacture and heat treatment. The most rigid demands for high-quality steels for purposes of engineering construction are being met satisfactorily with heat-treated alloy steels, and the increasing consumption of such steels means increasing and permanent demand for high quality ferroalloys. Referring to particular steels; increasing amounts of vanadium and chrome-vanadium open-hearth steels are being made, as well as nickel-vanadium steels. Molybdenum steel is growing in use, although the actual applications are not so extensive as its properties would suggest that they might be, and stainless steels are being employed more.

Gillett and Mack, in a paper before the American Electrochemical Society, have described experiments made in the U. S. Bureau of Mines on uranium, boron, titanium, zirconium, cerium, and molybdenum steels. It has been found that of these various steels, in the heat-treated condition, those containing molybdenum are the only ones that are greatly improved over ordinary steels. The other alloying elements are either

*Metallurgist, United States Bureau of Mines, Experiment Station, Pittsburgh.

decidedly harmful or have little effect upon the properties. Molybdenum has been shown to be a real and valuable alloying element for use in steel, and the applications of molybdenum steel will doubtless increase. Inasmuch as large deposits of molybdenum ores occur in the United States, it is of economic advantage to encourage the use of molybdenum steels rather than of certain other steels for which the alloying elements must be largely imported.

Further work has been done in the past year on alloy cast irons, notably by Smalley, who has examined the effects of copper, nickel, chromium, molybdenum, tungsten, and other elements on the quality of cast irons and the form of the graphite. With the development of pure electrolytic iron and carbon-free ferroalloys at lower prices, very pure steels can now be made in lots of reasonable size for experimental and special purposes. High-silicon cast iron for acid-proof castings is being used more, and further interest is being taken in silicon thermy. There is greater use of manganiferous iron ores in blast furnace and open-hearth practice. Cobalt magnet steels are finding increased employment.

### Ferromanganese and Spiegeleisen

Manganese ore mining picked up considerably in the United States last year but, even under the present tariff, market prices for ore of ferroalloy grade do not warrant extensive resumption of mining operations. On the basis of preliminary estimates, the production of 35 per cent ore was 40,000 gross tons,* as against 13,404 tons in 1922, coming principally from the Philipsburg, Mont., and the Batesville, Ark., areas. Imports of high-grade ore, chiefly from Brazil, British West Africa, Turkey, and British India were at the rate of 215,000 gross tons, as against 421,000 tons in 1922, and 401,354 tons in 1921. The 1923 output of manganiferous iron ore from the Cuyuna range will probably exceed the 1922 production (305,093 tons of 10 to 35 per cent ore). Stimulation to domestic manganese mining was given by the activity in the steel industry and by European competition for Indian, Brazilian, and Caucasian ore. More manganiferous zinc residuum was smelted to spiegeleisen than a year previous. In Arkansas, manganese mining is now on a conservative basis, and with reasonable costs most operators can make small profits at ruling prices. Many small operators who formerly recovered only lump ore are now washing the fines.

As indicated previously, there is a growing use for manganiferous iron ores of the Cuyuna range in blast furnace and open-hearth practice. The advantages to be gained in using these ores in the blast furnace are beginning to be understood by furnace operators, and larger tonnages of Cuyuna ore are being employed for basic mixtures. A higher manganese charge than that normally used is advantageous in open-hearth practice not only from the point of view of furnace operation and quality of the resultant steel but also because of saving in ferromanganese additions that would otherwise be required. It may be pointed out in passing that there has been a considerable decrease in the actual amount of both ferromanganese and spiegeleisen used per ton of steel produced in recent years, and this is probably largely attributable to the growing use of manganiferous iron ores. Hewett† states that although an average of 15 lb. of manganese was recently used per ton of steel produced, this has now dropped to 13.5 lb. The manganese deposits of East Tennessee have been discussed by Stose and Schrader in a recent publication of the United States Geological Survey (Bulletin 737), while those of the Batesville, Ark., district have been treated by Miser (Bulletin 734).

*All figures for production, imports and exports of ores and alloys for 1923 are merely estimates based on figures for 10 months of the year in most cases.

†Private communication, D. F. Hewett, Nov. 22, 1923.

The Russian manganese mining situation continues to be bad; Russia has half of the world's manganese supply and yet produced only about 33,000 tons in 1922, as compared with 1,200,000 in 1913. The present and past unsatisfactory condition is due solely to defects in the Soviet régime. Although Caucasian ore is of higher quality than other ores, it sold at lower prices in the European markets last year than Brazilian and Indian ores, and the freight rate on the former is cheaper. The imports of manganese ore into England in 1923 were about 500,000 gross tons, as against 337,308 tons in 1922, and 172,856 tons in 1921. Foreign manganese ore of alloy grade opened the year at $0.29 to $0.30 per unit, c.i.f. ports, rose to $0.43 to $0.48 in May, and declined to $0.38 to $0.42 at the close. Chemical ore sold at $75 to $80 per gross ton all year.

#### Ferromanganese Output and Prices

The domestic output of ferromanganese in 1923 was about 250,000 gross tons, as compared with 161,612 tons in 1922, and 98,439 tons in 1921. The spiegeleisen production in 1923 was about 124,000 gross tons, as against 70,253 tons in 1922, and 56,139 tons in 1921. The imports of ferromanganese in 1923 were about 109,000 gross tons, as contrasted with 94,952 tons in 1922, and 9060 tons in 1921, while the exports were about 4000 tons in 1923, as against 1107 tons in 1922, and 684 tons in 1921.

Domestic ferromanganese opened the year at $100 per gross ton for 78 to 82 per cent alloy, delivered, rose steadily to $130 to $135 in May, and declined to $107.50 to $110 at the close. English alloy was quoted at about the same prices as the American, f.o.b. port. In the case of spiegeleisen, the 20 per cent alloy opened at $34 to $36 per gross ton, delivered, Pittsburgh or Valley points; rose to $45 to $55 in April, held at $45 to $47.50 from May to September, and closed at $40. The 17 to 19 per cent grade opened at $33 to $35, rose to $44 to $46.50 in June, and declined to $39 at the close. German 76 to 80 per cent ferromanganese was quoted at $67 per ton c.i.f. port in the early part of the year.

As will be noticed from the production figures above given, there was marked increase in output of ferromanganese and spiegeleisen in 1923 over 1922, and this was, of course, owing to the greater output of steel ingots and castings. In the use of ferromanganese, further attention has been given to the employment of the liquid alloy in open-hearth practice, and Hodson has described a new four-electrode electric furnace designed especially for melting the alloy. It is stated that the amount of manganese required for deoxidizing can be reduced 30 to 40 per cent by using such a furnace for pre-melting. Manganese steel castings are being made more now by Southern foundries for sugar-mill machinery.

### Bessemer and Electric Ferrosilicons

The situation in electric furnace and Bessemer ferrosilicons and in silvery irons was better in 1923 than in 1922, and production increased both in the United States and Canada. This was due to greater demand for steel making, to greater activity in iron founding, and to the increasing use of high-silicon cast irons for acid-resisting castings. The demand for substantially pure silicon has been increased owing to the use of aluminum-silicon alloys.

The markets for all grades of ferrosilicons were strong during the year, and there was scarcity of the 50 per cent grade in the early months when shortage of power caused some makers to fall behind on deliveries. Ferrosilicon imports into the United States in 1923 were at the rate of 12,000 gross tons, as against 14,806 tons in 1922, and exports were about 900 tons in 1923,

as compared with 689 tons in 1922. Ferrosilicon production in Canada was at the rate of 26,000 gross tons in 1923, as against 9671 tons in 1922.

### Range in Prices

In 1923 prices for the various grades of ferrosilicons were as follows: In the case of Bessemer grades, the 10, 11, 12, 13, and 14-per cent alloys opened the year at \$44.50, \$47.50, \$51.10, \$55.10, and \$66.10 per gross ton, respectively; rose to \$48.50, \$51.80, \$55.10, \$59.10, and \$69.10 in May; held steady at these prices until July; and then declined to \$43.50, \$46.80, \$50.10, \$54.10, and \$59.10, where they held until the close. These prices are f.o.b. Jackson and New Straitsville, Ohio. Domestic and foreign 12 to 15 per cent electric furnace ferrosilicon was again competitive with the Bessemer grades; the alloy opened at \$38 to \$39 per ton, advanced to \$48 to \$50 in May, and closed at \$43 to \$50. The 50 per cent grade opened at \$82.50 to \$87.50 per gross ton (carloads), delivered, rose to \$95 in April, and declined to \$80 to \$82.50 at the close. The 75 per cent grade opened at \$115 to \$120 per ton, advanced immediately to \$150 to \$160, and closed at \$135 to \$155.

The use of higher silicon irons in the foundry for ordinary castings is growing as is the employment of the 13 to 15 per cent silicon-iron alloys for acid-proof castings. Various patents on iron-silicon alloys have been taken out in the past year, including patents on complex alloys containing tungsten and vanadium. Further interest is being displayed in silicon thermy, and a number of patents have been taken out for the production of metals and ferroalloys by silicon reduction.

### Ferrochromium and Related Alloys

As in 1922, chromite mining in the United States has continued flat, but the production in 1923 was larger than last year owing to increased demand. In 1923, the total imports and domestic sales were around 200,000 tons, as against 152,777 tons in 1922. In the United States, about 40 per cent of the chromite consumed goes into ferroalloy production, 35 per cent is used for refractories, and 25 per cent is employed in chemical manufacture. The Rhodesian mines are now operating on a larger scale than ever, and with those of New Caledonia will furnish three-fourths of the world's output. The Baluchistan (India) output has taken the place of the production formerly made by Russia and Turkey. Some deposits of the Transvaal are equal to those of Rhodesia but production has so far been minor.

Chrome ore, 48 per cent $Cr_2O_3$ basis, opened at \$18.50 per net ton, c.i.f. port, for the Indian, rose to \$21 in July, and closed at \$19.50; the Rhodesian and New Caledonian grades opened at \$23 to \$28, and gradually receded to \$21.50 to \$24 at the close. Ferrochromium, 60 to 70 per cent Cr and 6 to 8 per cent C, opened at \$0.11 to \$0.11½ per lb. of contained Cr, and was steady all year. The 4 to 6 per cent carbon grade opened at \$0.11½ to \$0.12, rose to \$0.12 to \$0.13 in February, and closed at \$0.12. The 1 to 2 per cent carbon grade sold at \$0.28 to \$0.30. In the first six months of 1923, 2220 tons of chromite were shipped to the United States from the Blake Lake district, Quebec, Canada.

### Stainless Products

Interest in so-called stainless steels, i.e., about 12 per cent chromium alloys with iron, continues unabated, and the production of these steels has increased the demands for chromite and ferrochromium. These steels are finding increased applications in hydraulic and steam-plant work. In a patent, Carney (U. S. Pat. No. 1,444,602, Feb. 6, 1923) suggests eliminating carbon from stainless steel, after adding of ferrochromium, by blowing the steel at very high temperature; according to the claims, at proper temperature, carbon is oxidized before chromium. A British firm has made stainless steel tubing 15 ft. long and 3 in. in diameter, and it is reported that stainless iron is being made in Sweden at the cost of mild steel. New developments of much interest are chromium plating and chromizing. Chromizing is done by diffusing chromium, by heating, into iron and steel (or other metals), yielding a surface layer of chromium-iron alloy. In the process, the material to be treated is packed in a mixture of 45 per cent alumina and 55 per cent chromium powder, and then heated at 1300 to 1400 deg. C. in hydrogen, vacuum or neutral atmosphere. The process is analogous to calorizing.

Chromized steel is good for resisting corrosion, but it has two competitors, viz., chromium plating and stainless steels. Chromium plating has not been applied much commercially, although the possible applications are numerous. Schwartz, in a paper before the American Electrochemical Society, discusses chromium plating and states that the best results are secured with 13.4 amp. per sq. dcm. and a solution of 3 gm. per liter of chromium sulphate and 245 gm. per liter of chromic acid; chromium anodes are used. A bibliography on stainless steel has been published by the Carnegie Library of Pittsburgh.

### Ferrotungsten

The domestic tungsten ore mining industry remains dormant, and the principal world producer is China. The French tungsten ore stock is not yet exhausted, and prices are too low to permit profitable operation of the mines. The Compania Minera Galaica has been organized at Pontevedra, Spain, for exploiting tin and tungsten deposits. The resumption of tungsten ore mining in the Ely, Nevada, region was planned by the Big Tungstonia Co. Wolframite opened at \$7.50 per unit of $WO_3$, New York, advanced to \$8.50 in April, and closed at \$8.50 to \$9. Scheelite opened at \$8 to \$8.50, New York, and advanced to \$9 to \$9.50 at the close. Chinese ore sold as low as \$8.50 duty paid (duty \$7.14). These prices are on the basis of 60 per cent concentrates. Ferrotungsten, 70 to 80 per cent grade, sold at \$0.90 to \$0.95 per lb. of contained W at the opening of the year, and later dropped to \$0.88 to \$0.90. Tungsten powder, 99 per cent W, sold at \$1 per lb. of contained W. Germany entered the wolframite market again last year.

High-speed steel continues to be the most important tungsten alloy, and the consumption of tungsten is largely dependent upon the demand for this steel. An extensive investigation on the metallurgy of tungsten has been started by the U. S. Bureau of Mines. Skelley and Merson (U. S. Pat. No. 1,437,271, Nov. 28, 1922) have patented a process for the production of ferrotungsten in which silicon, or ferrosilicon, is the reducing agent; in the process, tungsten ores are mixed with silicon, or ferrosilicon, and a suitable reagent containing nitrogen, e.g., sodium nitrate, and the mixture is thermited. Ferrotungsten practically free from carbon and silicon is said to be made by the process. Study has been made of the iron-carbon-tungsten system by Ozawa.

### Ferrovanadium

Efforts are being made to develop the vanadium-bearing deposits of some of the Western States, particularly those in Arizona, California, New Mexico and Nevada. In these states, some 400 deposits have been found, and 64 of them show commercial possibilities. The ores are principally lead vanadates, and methods for their treatment and utilization for the production of ferrovanadium have been worked out by Baughman, who discusses the metallurgy of lead vanadates in a paper before the American Electrochemical Society. Vanadium ore production in Peru and the United States

is still small. A vanadium deposit is being opened in Garfield County, Colorado, by the Vanadium Corporation of Colorado, and the indicated yearly production is to be 10,000 tons of ore containing not less than 400 tons of vanadic oxide. Some ore from this source has been shipped east during the past year. Another development of vanadium is reported from Emery, Utah. The Standard Chemical Co. resumed operations and was treating about 100 tons daily of what was formerly considered waste material, chiefly for its vanadium content. In a recent Russian report, Kolovorot-Tchervinsky discusses the possibility of extracting vanadium from Russian deposits that contain 3.36 per cent $V_2O_5$ and are now being worked for radium.

Vanadium ore, 18 per cent $V_2O_5$ minimum, sold at $1 per lb. of contained $V_2O_5$ during 1923; vanadium pentoxide, 99 per cent, was $12 to $14 per lb.; and carnotite sold at $3.50 to $3.75 per lb. of $U_3O_8$. Saklatwalla and Anderson (U. S. Pat. No. 1,435,742, Nov. 14, 1922) have been granted a patent on the new electric furnace process used by the Vanadium Corporation of America for the production of ferrovanadium, described in this review last year. Ferrovanadium, 30 to 40 per cent V, sold at $3.50 to $4.50 per lb. of contained V, during 1923.

### Ferromolybdenum

There was no molybdenum ore mined in the United States in 1923, and so far as is known none imported. Production in Canada, Norway, and Australia has not been resumed. Prices for concentrates have been largely nominal. Molybdenite concentrates, 85 per cent $MoS_2$, opened at $0.55 to $0.65 per lb. of contained $MoS_2$, duty paid, New York, rose to $0.75 to $0.85 in April, and held there until the close. The capacity of idle flotation mills for treating molybdenum ores is as follows: United States, 1250 tons per day; Norway, 250 tons; Canada, 250 tons; and Australia, 200 tons. These mills operating at capacity would produce the equivalent of 2000 tons of molybdenum per annum. An important bulletin on molybdenum ores has been published recently by the Imperial Institute (Great Britain).

#### Molybdenum as a Steel Alloy

The use of molybdenum steel continues to increase, but the demand has not been developed to the extent which would be suggested by the properties and value of the steel. Molybdenum is a valuable alloying metal for use in steel, and apparently only inertia prevents its wider use. Since the first cost of molybdenum steel is no more than that of any other alloy steel with comparable properties, and since its use is often attended with reduction in machining costs, it will undoubtedly be more widely employed in the future. Gillett and Mack, in the U. S. Bureau of Mines, and others have recently studied molybdenum steel at length and find that the material is a valuable addition to the present list of alloy steels. Cutter* states that molybdenum steel is now being used in mill rolls, it having been found that a small percentage of molybdenum in both steel and cast iron rolls increases the life.

Ferromolybdenum, 50 to 60 per cent Mo, sold at $2 to $2.50 per lb. of contained Mo all year. In a patent which has just come to hand, Turner (English Pat. No. 184,912, June 1, 1921) suggests making carbon-free ferromolybdenum by the thermit reduction of a mixture of molybdenum oxide, aluminum, iron oxide, and pyrolusite; the resultant alloy contains 60 per cent Mo and 1.5 per cent Mn.

#### Ferrotitanium, Ferrouranium and Ferrozirconium

Robinson, in a valuable report published by the Canadian Department of Mines, discusses the metallurgy of titanium, its properties, uses, compounds and alloys. The titanium deposits of Canada are considered at length, and it is pointed out that there are large bodies of ilmenite, readily accessible in Quebec, and that these deposits are sufficiently large to meet all probable demands for many years. The consumption of ferrotitanium and ferro-carbon-titanium in the United States was about the same in 1923 as in recent years, and nothing of note has transpired in the use of titanium in steel metallurgy. Domestic supplies of titanium ores are ample to supply all demands, but small shipments are made to this country from Canada. Carbon-free ferrotitanium has been used in Europe for making electric steel containing 0.5 to 7 per cent Ti. Work by Gillett and Mack shows that titanium-bearing steels are no better than comparison steels not containing titanium.

Rutile sold for $0.10 per lb. for 96 per cent $TiO_2$ concentrates all year; and ilmenite, 52 per cent $TiO_2$, opened at $0.01¼ to $0.02 per lb. and declined to $0.00¾ to $0.01. Ferro-carbon-titanium, 15 to 18 per cent Ti, sold at $200 to $225 per net ton, f.o.b. Niagara Falls.

#### Uranium in Steel

Very little is heard now concerning uranium steels and the use of ferrouranium in steel metallurgy. The cost of uranium and the difficulty in introducing it into steel without excessive loss and the formation of dangerous inclusions have mitigated against its employment. Moreover, the properties of uranium-bearing steels are not outstanding and similar properties can be obtained with cheaper alloying agents. Uranium ore (carnotite) sold at $3.50 to $3.75 per lb. of $U_3O_8$ for 2 to 2.5 per cent grade. Ferrouranium, 35 to 50 per cent U, sold at $6 per lb. of contained U until July and then dropped to $4.50.

Little progress has been made in the past year in the use of zirconium in steel metallurgy. At the May meeting of the American Electrochemical Society, F. M. Becket stated that an exhaustive investigation had been made by the Electro Metallurgical Co. of America on the effect of zirconium on steel, pointing out that it has good scavenging and desulphurizing qualities and that it eliminates the red shortness of high-sulphur steel on rolling. It was also pointed out that the physical properties of ordinary and alloy steels are materialy enhanced, in the heat-treated condition, by the presence of a small amount of zirconium. Gillett and Mack, in their experiments in the U. S. Bureau of Mines, however, find that while zirconium may have some possibilities as a scavenger, its effects upon the physical properties of steel are slight. Zirconium silicate sold at $0.04½ to $0.13 per lb., f.o.b. Florida, in 1923, depending upon the grade.

### Minor and Complex Ferroalloys

A rather quiet period passed in 1923 in the use and development of minor steel-making metals and special ferroalloys. Gillett and Mack find that while boron gives high recovery on addition to steel it is not good as a deoxidizer and does not appear to be of any use in steel. Considerable interest is displayed in cobalt for use in magnet steels; at the last British motor show 30 per cent of the magnetos were fitted with cobalt-steel magnets. A cobalt-chromium steel containing up to 18 per cent Co, up to 1.5 per cent Cr, and over 1 per cent C is being made in England; this is suitable for air hardening and is said to have excellent properties. Cerium has been shown to be a good desulphurizer for steel, but it gives rise to bad inclusions. A special tool alloy containing 50 per cent Co, 25 Cr, 15 W, and 5 per cent Ta, plus small amounts of C and Si is patented by McCurdy (U. S. Pat. No. 1,449,338, March 20, 1923). Silico-spiegel and silico-manganese are still being used, but this use is not increasing.

*Private communication, J. D. Cutter, Nov. 28, 1923.

# European Industry Hopes for Ruhr Peace

## Germany on Gold Basis Faces High Costs—France and Belgium Increase Exports—Britain Foresees Further Depression When German Reparations Are Resumed

DISRUPTION of business conditions, indirectly at least, as a result of the political situation, seems to have been the dominant fact of European iron and steel markets in 1923. British business entered the year quiet and with prices generally stationary. German business was enjoying an active export trade as a result of a slowly depreciating currency. French industry, as the new year opened, was quiet but anticipation of the new and more drastic attitude of the Government to speed reparations settlement was beginning to animate business. Coke was stiffening in anticipation of the shortage that was to come and many producers were looking forward pessimistically to the loss of their Eastern outlets for products. Belgian business was in much the same situation, except that being a greater exporting country than France, German competition was more keenly felt.

When the Ruhr was occupied on Jan. 11, European business took the turn that has characterized it throughout the year. Reparation coke deliveries ceased and it was only gradually and on an extremely limited scale that deliveries were made during the rest of the year. The coke shortage, from which all Europe has suffered in 1923, was probably most keenly felt by Luxemburg. French industry was also a great sufferer from scarcity and high prices. Belgium, with a fairly large coking capacity of her own, supplemented by small reparation deliveries and heavy importations of coking coals and some coke from the United Kingdom, probably surmounted the fuel difficulties as well as, or better than, her neighbors.

British industry, as a result of the coke shortage on the Continent faced a rapidly rising market, as British coal mines and coke ovens made efforts to meet the demand from abroad. On the whole, the initial result of the Ruhr occupation was partly favorable to the British iron and steel markets, as it also favored certain European countries not directly interested in the occupation, such as Austria and Czecho-Slovakia, which suddenly experienced an active export demand, particularly from German industry in unoccupied regions, forced to find a source of supply other than the Ruhr, for semi-finished material.

At the beginning of the year, domestic and export inquiry in the United Kingdom had been poor, but toward the end of January, the Ruhr occupation had almost completely altered the aspect of this situation. With German sources of supply cut off, the Continent began to inquire in England and a fair volume of orders was placed at advancing prices for all classes of material, including fuel and pig-iron.

Despite the gloomy aspect of the situation, Britain is, adopting a broad view of the past few years, evidently emerging by slow and painful degrees from the wreckage of the war. Costs of everything in which labor forms a material item are enormously high and apparently this condition will continue indefinitely.

The day of low-priced German competition seems to have definitely passed with the new turn of events, since the cessation of passive resistance and the gradual establishment of German prices on a gold or rentenmark basis. Germany's mines, blast furnaces and steel mills are better equipped than before the war. Corporations have paid off bonded debts and with small defence forces and no national debt but reparations, a satisfactory adjustment of the Ruhr situation, it is believed, should see a gradual revival of the iron and steel industry in Germany.

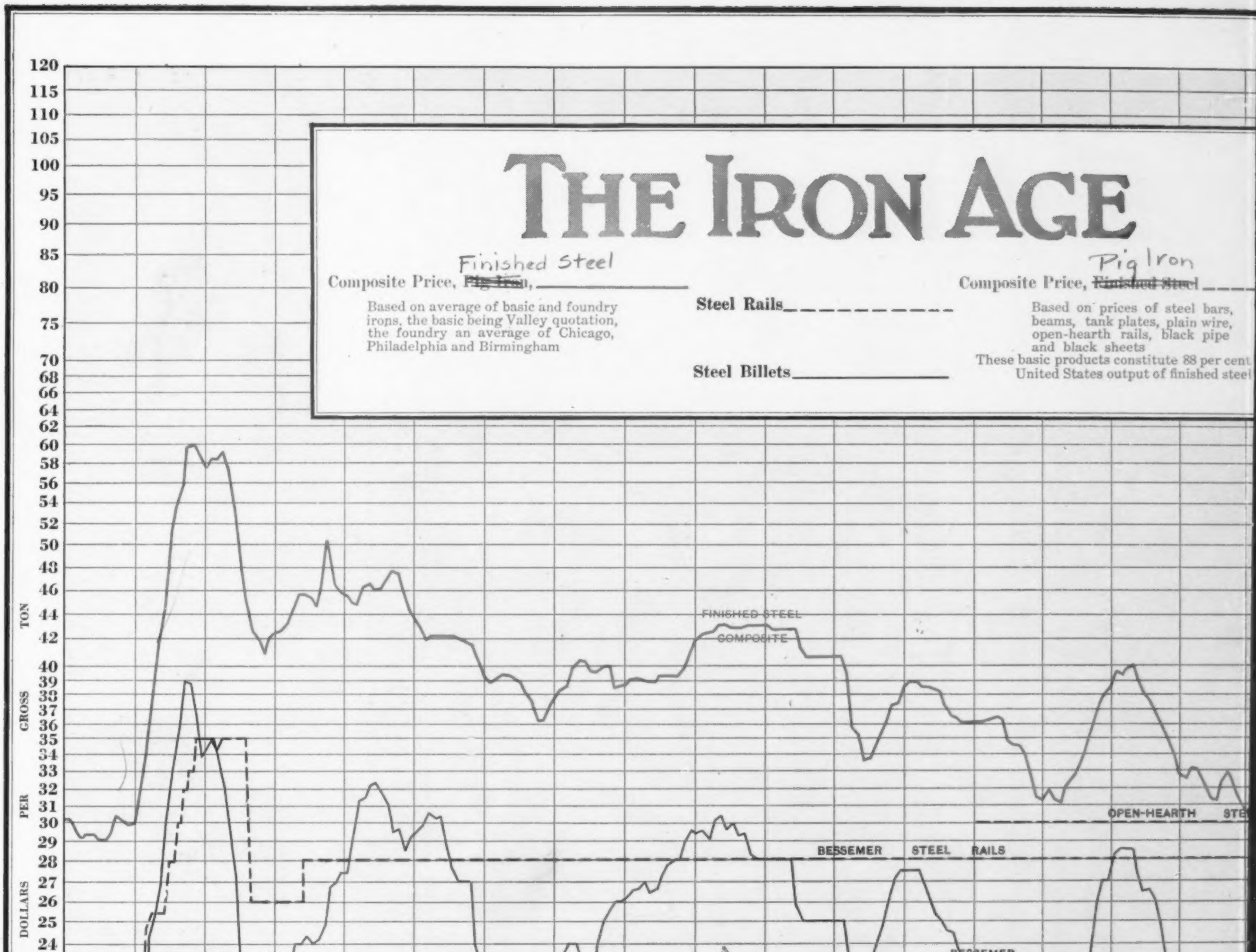
In France and Belgium, 1923, despite the unsatisfactory political events has been a year of constructive activity in industry. In 1921 many French iron and steel plants encountered heavy losses and 1922 was but little better, marked only by the resumption of work in some devastated plants. Had the occupation of the Ruhr not occurred early this year, 1923, it is believed, might have seen a marked revival of business and advance in production.

Belgium has seen a fairly active although sporadic export trade during the year, a continued depreciation of the franc and a good production of pig iron despite the coke scarcity. On the whole, Belgian industry, despite more strikes and more increases in wages to labor, seems to have fared better in 1923 than French industry. France has experienced a severe shortage of coke, a depreciated exchange, not as great as the Belgian, however, and a generally unsettled and fluctuating market, partly through lack of confidence in the future as a result of the continued misunderstandings with Great Britain and Italy over the Ruhr situation. Although French wages were not increased as greatly as the wages of Belgian workers, a comparison of the two with the dollar as a basis shows practical equality, through less depreciation of the French franc. Throughout French, Belgian and German industry there is evident a certain degree of expectation of settlement in the Ruhr before long and a feeling that the removal of this obstacle will permit a continued and rapid recovery from the results of the war.

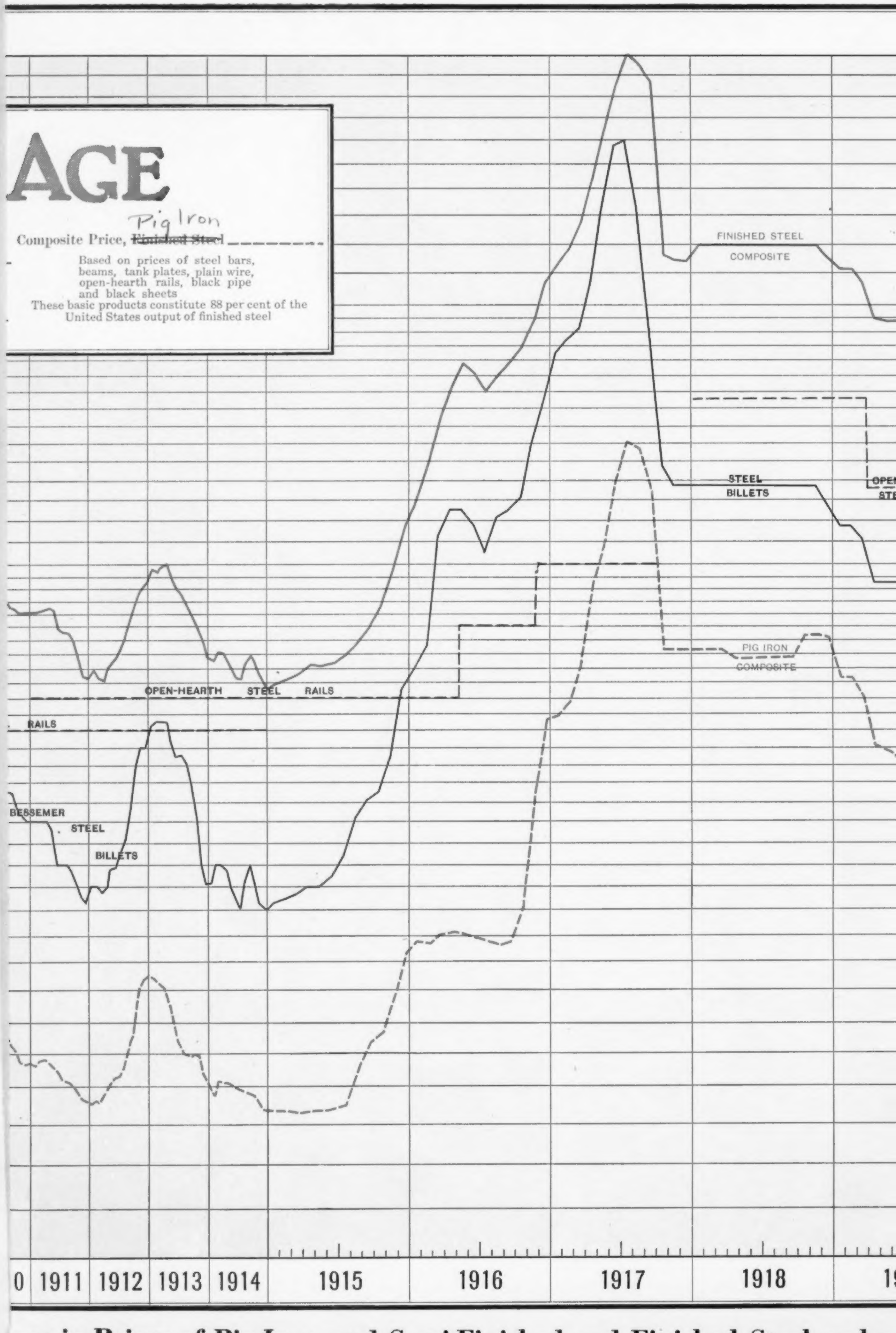
# British Production Makes Progress—Tin Plate Extremely Active —Continental Demand Increases Coke Prices—Pig Iron Weak

TAKING the year as a whole, conditions in the British iron and steel trades have been none too bright, except in a few products, such as tinplates and galvanized sheets, which have enjoyed a period of activity and prosperity in marked contrast with conditions prevailing generally in most other lines. At the beginning of the year buying on home and export account was poor and prices almost stationary. The French occupation of the Ruhr, however, had completely altered the aspect of the situation by the end of January. With important German sources of supply thus cut off, the Continent began to rain inquiries upon British manufacturers, and sizable orders were placed at advancing prices for all classes of material, including fuel and pig iron.

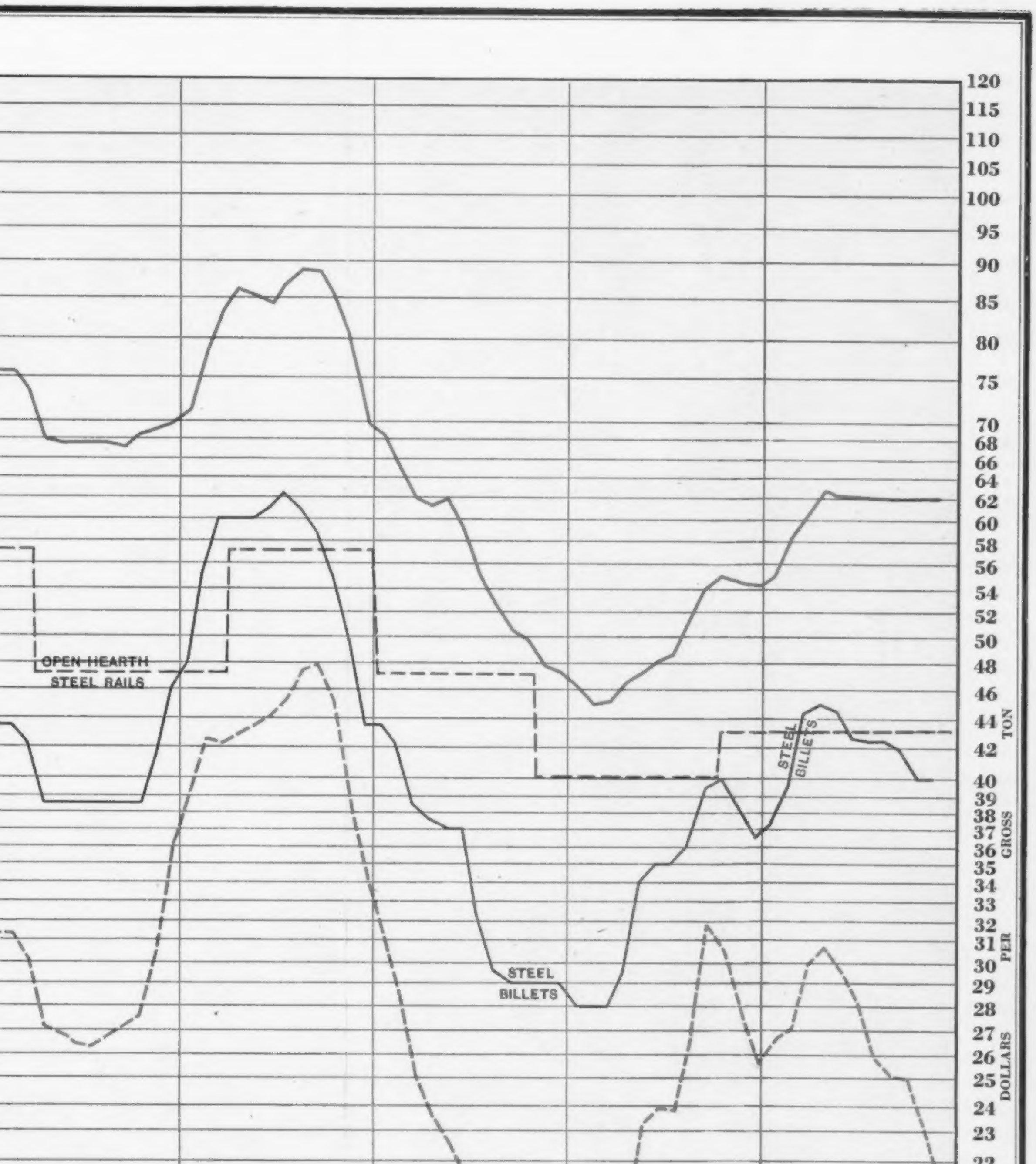
Cleveland pig iron is the index of values in the British pig iron industry, and by tracing the course of events in this particular area, one is practically following the progress of affairs throughout the country. Cleveland iron prices, after jumping to 125s. in the early part of the year, following the occupation of the Ruhr, weakened, and from shortly after Easter until




## 26 Years of Fluctuations in Prices of Pig




**ons in Prices of Pig Iron, and Semi-Finished and Finished Steel and o**




**nd of Steel Rails**

October there was one long succession of reductions, all ineffective in stimulating business.

### Shipyard Strike Proved Costly

One outstanding adverse feature of the year was the long-protracted dispute in the shipyards, started by a lockout of boilermakers, which had crippling effects in all directions, and in time reduced the shipyards to a state of almost complete stagnation. This dispute, which continued for 30 weeks, and which was not brought to a close until the end of November, cost the country about £6,000,000 in wages and indirectly involved more than 50,000 men.

Toward the end of October, partly because of this strike, No. 3 Cleveland was down to 94s., but gained a few shillings in subsequent weeks. It is difficult to prophesy future developments with any confidence, for so many conflicting factors must be taken into consideration, but there is sound reason for believing that domestic trade is entering upon a period of expansion. This growth of confidence is especially noticeable among consumers of pig iron, many of whom have been buying heavily, and some of whom are stated to have already covered their requirements for the whole of 1924. The steel trade also appears healthy, both in domestic and export business.

The production of iron and steel this year shows a vast improvement upon that of 1922, the total pig iron production promising to be in the neighborhood of 7,500,000 tons, and that of steel about 1,000,000 tons more.

### A Prosperous Year in Tin Plate

In the tinplate trade, which can be regarded as in a category of its own, 1923 has proved to be even better than its predecessor. That Welsh tinplate makers are holding their own in the world in the way of low cost of production seems undisputed, and the growing importance of tinplate as a necessity to life is becoming more and more evident. The enormous war stocks of canned goods in the belligerent countries have been cleared away, and must of necessity be in part replenished, while neutrals in the great struggle are relying more and more upon imported canned goods. Moreover, further uses for tinplate as packing and containers are being found, while the British Empire is endeavoring to develop its natural industries, and this is stimulating the export of canned food products. The use of oil as a substitute for coal has expanded greatly, and with the consequent developing of oil resources, the call for containers increases. Several countries beside Wales and the United States have endeavored to produce their own tinplate, but in most cases have failed, despite protective tariffs, and have turned to one of these two sources for supplies. The stabilization of Welsh prices has gone a long way toward putting the trade on its feet again, following the slump of the previous two years, and according to the statistics of production in September (the latest available), the output is at the rate of about 715,000 tons a year, the highest since 1914. At the beginning of the year trade was none too brisk, with the minimum price of 20s. 6d. basis I.C., f.o.b. With raw material advancing, as a result of the Ruhr occupation, the price increased to 24s. base by the end of March. In May a reduction of 10½d. base was made, but in November this was advanced to 23s. 6d. base, and it is believed that further increases are imminent. The usual fall demand, both domestic and foreign, appeared with greater keenness than was expected, and during the past two months manufacturers have filled their order books for two or three months ahead, with inquiries still coming in for shipment up to the end of the second quarter. In 1924, therefore, the tinplate trade should apparently continue to enjoy its new-found prosperity. At the beginning of the year there were 383 mills operating in Wales, and by June this number had increased to 410 mills. By September 391 mills were working, but by the end of the year the 400 mark was again overtopped.

### Exports of Galvanized Sheets Disappointing

Business in galvanized sheets has been good, the output for the first nine months of the year (the latest figures available) being at the rate of about 670,000 tons a year, or about 70,000 tons better than in 1922. The largest foreign consumers are India, Australia, South America and South Africa, but none of these has taken its normal quantity. The Indian demand is largely seasonal. Great disappointment has been felt at the absence of a revival in the ordinary bazaar trade, and undoubtedly stocks in "godowns" are being held down to the lowest possible limits. The boom of 1920, when as much as £60 per ton was paid for 24-gage corrugated sheets in bundles, against an average pre-war price of about £12, was something of a shock to Indian merchants, and when the slump in prices came in the following year, many were left with high-priced stocks. Consequently, ever since, their attitude has been one of extreme caution. The earthquake in Japan brought a revival of demand for thin galvanized sheets and makers quickly filled their order books for some time ahead. The Japanese call for galvanized material has diminished during the past few years as a result of the expansion of their own galvanizing plants and the recent demand was welcome. It was, however, satisfied within eight to ten weeks and the end of the year finds makers with orders for about the first quarter, but no sign of further business coming from Japan. The base price in the beginning of the year was £17 15s., f.o.b.; increased to about £20 by the first half of the year, declined to £17 15s., f.o.b., by the end of July, recovered to £19 in the following month on Indian purchasing, but by the end of the year had eased off 5 to 10s. a ton. The outlook for 1924 beyond the first quarter is difficult to forecast, but capacity was considerably enlarged during the year and is to be increased further.

### Future Depends Upon Ruhr Settlement

The coming year is generally expected to be better than 1923. The question of fuel costs, however, is of paramount importance. The excessive price of coke has rendered pig iron production unremunerative for months past, and there is no present indication of any easier conditions. The situation in the Ruhr must change greatly and the needs of unoccupied Germany will have to be satisfied before British consumers can look for much lower coke prices in this country. Therefore, there would appear to be slight prospect of a decline in pig iron values here as long as fuel prices are maintained at the present level, and any further expansion in the domestic trade, coupled with a renewal of export business, should indeed entail even higher figures. The outlook for steel depends largely upon the effects of an industrial settlement in the Ruhr, with a liquidation of the stocks there and the marketing of future production. If a settlement goes through on the lines forecasted, it might gravely affect the whole steel situation, and in its earlier stages the chances seem to be that such a settlement would prejudice exports of British steel and thus react upon our domestic market. It is felt that domestic business next year must be better than in the twelve months just ended, if only because the railroads have extensive programs in preparation, involving expenditure of many millions of pounds sterling, practically all to be spent in this country. The efforts of Mr. Baldwin, the Prime Minister, to obtain protection, met with very disappointing results from his point of view, although his policy was largely supported by the steel manufacturers. For a generation, probably, this anticipation has been doomed to disappointment, and a factor that would certainly have exerted a most profound influence on the course of business and prices during the future has been eliminated.

### Labor Costs High

Looking back over the past few years, it will be seen that Great Britain has been, and is still, emerging by slow and painful degrees from the wreckage of the war and from the stupefying dreams of the promised Elysium with which the populace had been befooled. The manual workers, in particular, have experienced a severe disillusionment and have been expressing their resentment by resistance, both active and passive, to the recognition of post-war facts; hence the strikes which have been going on, and the generally doubtful willingness of labor to give fair services for wages received. Costs of everything in which labor forms a

material item, such as building, are still enormously high, and from present appearances will continue so indefinitely. Great Britain shall, nevertheless, have a bigger production and also a bigger consumption of iron and steel during the next twelve months than during the last, and if business were permitted to follow a normal course, free from labor troubles and political complications at home and abroad, prices would probably be generally lower. The future, however, holds highly complicated problems to be solved and there is little chance of conditions reverting to what may be regarded as normal. A great deal depends upon the drift of events on the Continent. Part of Britain's recent troubles have arisen from the dislocation inevitable upon absorbing reparation payments in cash and in kind, and more of this trouble will follow, for obviously Germany can pay in only one or the other. The bigger the reparations paid, therefore, the worse for British industry and trade. What is quite certain is that when once conditions become settled on the Continent, a market will have to be found for huge quantities of iron and steel, and that if Britain does not absorb its share of this material and work it up, it will be worked up elsewhere and absorbed by the foreign buyers, upon whom British industry is dependent largely for support.

# German Industrial Activity at Low Ebb—Gold Mark Prices Above World Level—Unemployment Attains Staggering Proportions

FOR Germany's iron and steel industry and trade, 1923 brought a radical change for the worse and left prospects for 1924, which are at best doubtful. Earlier post-war years, although bringing ever greater currency depreciation, brought also undoubted industrial recovery. As a result of the chronic shortage of heavy iron and steel entailed by the loss of Alsace-Lorraine, these two branches worked steadily at full capacity. Recovery was slow but steady, from an estimated production of 5,657,000 metric tons of pig iron in 1920 to an estimated 8,400,000 tons in 1922 (no official figures since October, 1919) and from 6,730,000 tons of steel to 9,370,000 metric tons in 1922.

For 1923 not even an estimate can be given. The whole metal industry was affected by the occupation of the Ruhr in early January. Although smelting and steel production during the first occupation months were continued for stock, later they ceased entirely, the workmen being put on repairs, extensions and technical improvements. After January, no figures of Ruhr coal production were issued.

### Austria and Czecho-Slovakia Profit

The Ruhr iron and steel industry must be considered as non-existent in 1923, while that of Upper Silesia, including the territory ceded to Poland, gained as did the industries of Austria and Czecho-Slovakia. The serious collapse of smelting was accompanied by a heavy decline in iron ore imports. How other countries profited is shown by the increase of Austria's iron, steel and heavy hardware exports from 16,000 metric tons in the first half of 1922 to 53,000 metric tons in the first half of 1923, while Czecho-Slovakia's exports increased from 17,000 to 88,000 metric tons for the same two periods. The serious condition of the Ruhr heavy iron and steel production did not at first injure the iron and steel consuming industries of unoccupied Germany. These industries imported material from Austria, Czecho-Slovakia and England, but later there was a serious decline in production of machinery, cutlery, hardware and miscellaneous iron and steel goods. This was in part the result of a shortage of raw materials, but chiefly the result of high prices brought about by the general adoption of gold mark pricing in the late summer, which in the end led to stagnation of business throughout the country. In particular, Solingen, Hagen, Schmalkalden, Velbert and other centers of production of cutlery and small manufactures of iron and steel suffered, while the locomotive builders lacked sufficient orders, both domestic and foreign, throughout the entire year.

### Currency Depreciation Precluded Capital Increases

Despite much greater currency depreciation in 1923 than in 1922, shortage of capital did not hamper the iron and steel industry as much as in the previous year, largely because of the general slackening of trade and the fact that the State, using the printing press, guaranteed to all corporations in occupied territory, sufficient money to cover the cost of wages and raw materials. This State measure was made necessary by the French prohibition of export or transport into unoccupied territory, as a result of which the corporations lost their sources of revenue. Later, the State paid unemployment allowances on a large scale. The large steel companies intentionally refrained from increasing their capital because, before the necessary official formalities could be fulfilled the paper-mark capital applied, decreased in value to almost nothing. Hence, although the currency toward the end of 1923, fell to about the 1/600,000,000 of its value at the close of 1922, paper mark increases in capital in eleven months totaled only 203,872,000,000 marks, or four times the 46,039,000,000 marks raised in the twelve months of 1922. In November, the State, for financial reasons, ceased advancing money to industry and in 1924 the steel industry will have to finance itself.

### Gold Mark Reckoning Brings Prices Above World Level

Pig iron prices throughout the year were fixed at compulsory maxima by the Iron Industry Union and steel "guiding" prices, not legally compulsory, by the Steel Syndicate. Early in December, the Steel Syndicate abolished all price-fixing, leaving its members entirely free. Early in the year, German iron and steel, in accord with the general low price level and low railroad rates, were cheaper than foreign prices, but with the adoption of gold mark calculation, prices rose far above world-market level. As a result, in November, the Government was obliged to abolish the coal tax, which in 1922 had been reduced from 40 to 30 per cent of the selling price. In occupied territory, however, the French and Belgians continued to collect the coal tax. Gold mark prices for coal and steel syndicate products were adopted in September, while pig iron prices were fixed in British currency. In all cases, however, payment was legal in paper marks at current exchange. In the fall, when British bars were quoted at £9 to £9 10s per metric ton, the German price was about £11 5s. Numerous objections were made by consumers to the price policy of the Steel Syndicate and in November the consumers' representatives, as a protest, resigned from the syndicate's price committee. At this time, the Eisen und Stahlwaren-Industriebund of Elberfeld, which represents the machine manufacturers and other industrial consumers, demanded from the Government a systematic price reduction policy, including free importation of materials for manufacture, complete abolition of export control and of the sales tax on exports and provisions for State credit.

From the beginning of the year paper mark iron and steel prices increased rapidly until the paper mark was altogether abandoned in principle. The highest paper mark quotation reached for foundry iron, No. 1, was 99,450,000 marks per metric ton. This was more than a million fold the 75.50 marks per metric ton prevailing before the war. As 1923 comes to a close, stable-currency prices are: Foundry iron No. 1, 122s 6d ($26.58) per metric ton; ingots, 151.40 gold marks ($36.03) per metric ton; bars, 219 gold marks ($52.12) per metric ton, and thin sheets 344.80 gold marks ($82.06) per metric ton. Had paper mark pricing been retained for metals, prices in early December would probably have been 2,000,000,000,000 fold those of 1914.

The index figure for all commodities on Nov. 29 was, on a basis of 1 in 1914, 1,617,000,000,000 fold that of 1914.

As a result of high-priced coal and foreign ore, and a heavy demand, iron prices throughout the year have been above the general price level. As State railroad freight rates, long very low, have been definitely established on a gold mark basis, with iron and steel rates averaging 65 per cent more than in 1914, the era of excessively cheap German production is probably ended for good.

**Unemployment Probably at 3,000,000**

Chaos in the Ruhr with its reaction on unoccupied territory, coupled with high prices based on gold mark calculation, since the final decline of the paper mark, which killed business, have radically changed the labor situation for the worse. Between the armistice and October, 1922, unemployment rapidly and with certain fluctuations steadily fell, reaching a low point of 17,916 registered unemployed on Oct. 1, 1922. The proportion of unemployed in the iron and steel labor unions was then only a fraction of 1 per cent. After that there followed a slight decline in employment, which became accentuated in the first half of 1923 and in the second half of this year assumed dimensions which threaten a catastrophe. The last published official figures, Sept. 29, showed 500,000 unemployed and 1,790,000 on part time, from a total of 5,000,000 registered labor union members. But as wholesale suspension of operations and discharges on a large scale occurred in October and November, the unofficial estimate of 3,000,000 wholly unemployed in December, is probably not exaggerated. At the close of October, the unemployed in the Metal Employees Union, which consists chiefly of iron and steel workers, was 18.9 per cent of the membership, with 51.39 per cent working part time. The majority of these part time workers, 45 per cent of all metal workers, had been reduced from 17 to 25 hours a week. In the Solingen district alone, in mid-November, there were 42,000 unemployed.

**Germany Without Working Hours Regulation**

Labor, on the whole, increased in efficiency during the year, but in the past few weeks, probably as a result of a decline in the average real wage and undernourishment, per capita production in many metal plants has declined. Strikes have been neither numerous nor serious. The so-called "Arbeitsgemeinschaft," or working community between employees and employers, established from patriotic motives in 1918, is threatened with disruption. The 8-hr. day, which also dates from 1918, is practically a dead letter. The Stresemann cabinet introduced a bill extending the maximum working day in hygienic industries to 10 hours, while for sub-surface mining and unhygienic branches of industry, the 8-hr. day was established as a maximum. In practice and by agreement, the working day in underground mining has lately been 7 hours. The Stresemann bill has not yet become law, but because of the failure of the Government in November to prolong the temporary 8-hr. day decree, Germany is now without any working hours regulations, excepting those existing under the pre-war social legislation. The Socialists, however, deny that this is the legal position. The 8-hr. day has been attacked by many prominent Socialists as a luxury which Germany in her present condition cannot afford.

**Foreign Trade Seriously Curtailed**

Foreign trade in iron and steel suffered seriously from the Ruhr occupation. Heavy importation of coal into unoccupied Germany was necessary to compensate for the loss of the Ruhr deliveries, iron ore imports declined and exports of heavy iron and steel, machinery and all metal products of importance were curtailed. The collapse of machinery exports on one side and the increased coal imports on the other, heavily burdened the already barely equal trade balance and were an additional cause of mark decline. After the great rise in October and November of gold prices, export was further affected by the Government's refusal on financial grounds to continue compensating exporters for the 26 per cent of the purchase price, deducted by British buyers, under the Reparations Recovery Act. Manufacturers claim that State finances will suffer more from the cost of supporting the additional unemployed than they would have suffered by compensating the exporters. The metal industries have been also seriously affected by the cessation of all reparations deliveries in kind to Allied countries.

**Few Large Business Mergers Formed**

Large business combinations were not formed during the year. The principal feature was the increase in power and magnitude of the Cologne-Otto Wolff Trust, grouped about the Phoenix Co., which has delivered large quantities of material to Soviet Russia. Recent reports state that the Stinnes corporation is to be reorganized, all companies with headquarters in occupied territory, which are under French control, to be largely separated from companies in unoccupied territory. The Westphalian Coal Syndicate, the term of which expired during the year and was temporarily renewed, is to be prolonged on a new basis, the constituent companies being combined into groups. Two leading coal producers, Stinnes and Klockner were inclined to favor complete dissolution of the syndicate, which was formed by Stinnes' associate, Emil Kirdorf, but the kind of regrouping ultimately agreed to will strengthen both Stinnes' and Klockner's positions.

In November, the Stresemann cabinet, as its last official act, under the Economic Dictatorship, established State control of corporations and cartels, by creating a cartels court, with power to dissolve and requiring that the conditions of all combinations be embodied in a written agreement between the combining companies. This measure seems chiefly to have been intended as a Government retort to the action of the Wolff and Stinnes interests in negotiating independently with the French occupying authorities, but in part the measure was designed to protect metal-consuming manufacturers. As a result of the new law the selling conditions of some of the large companies have been modified.

**Unfavorable Outlook**

Prospects for 1924 are not at present favorable. The principal unfavorable factor is the continued Ruhr occupation, which operates as a permanent irritant to German trade and industry. In particular, the still existing customs frontier between occupied and unoccupied Germany is an obstacle. Only optimists believe that the partial agreements between individual Ruhr groups and the French authorities will result in smooth working and cooperation. A second unfavorable factor is that while the Ruhr steel companies have undertaken to make costly deliveries in kind and to pay to France the heavy coal tax, which has been abolished in unoccupied Germany, the Berlin Government adheres to its decision not to compensate these companies, so that although certain portions of the Ruhr deliveries, will be booked to Germany's credit in the reparations account the companies must, for the present, finance these deliveries themselves. That financing, if possible at all, can only be accomplished by throwing the burden, probably in the shape of high prices, on German consumers.

**Low German Costs At An End**

Germany probably will never return to the low production cost and profitable dumping stage of the past. Such a return is now precluded by the establishment of stable gold prices for materials, wages, freight and Government charges. Even though the new rentenmark currency collapses, the lowering of gold mark prices will not be involved. If on the other hand, currency stability is attained, Germany will almost inevitably pass through an inflation crisis.

Fundamentally Germany is sound. The German mines, blast furnaces and steel mills are better equipped than before the war; the corporations have relieved themselves of their bonded debts and with

small defense forces and the extinction of the domestic debt, taxation will be relatively small. A satisfactory reparations and Ruhr settlement in the coming year, as seems in no manner improbable, would, therefore, see a marked revival in the iron and steel industry.

# Strong Desire in France for Ruhr Settlement—Depreciated Franc a Spur to Export—Unemployment Almost Eliminated

DURING the whole of 1923 the French iron and steel industry has existed in an unsatisfactory atmosphere of continual coke shortage and fluctuations of exchange. Prices have frequently changed according to the price of coke and particularly as a result of a low or high level of production. A noteworthy feature has been export trade, which has increased with the rates of exchange on sterling. Above all, business activities have been largely dependent upon political events, which, of course, have resulted in hesitancy as to the future in business. The misunderstanding with Great Britain and Italy on the Ruhr policy is, unfortunately, one of the principal reasons for this lack of confidence, and as such misunderstanding still exits, 1924 opens under relatively unfavorable circumstances. Consequently, there is a strong desire in France for a prompt settlement of the problems of reparations and inter-allied debts, as it is realized that as long as these problems continue unsolved, the political atmosphere will be unfavorable to the extension of trade.

### Coke Supply Gradually Improving

Available statistics on coke production and deliveries on reparations show that French production has been progressing regularly each month for about a year. From November, 1922, to September, 1923, the production of coke doubled, largely as a result of the restoration of the Nord and Pas-de-Calais coke ovens, destroyed in the war. But there is still much to be done before the pre-war level of coke production is reached again. In 1913, coke from French mines amounted to 2,635,000 metric tons, including 2,445,000 metric tons from the Nord and Pas-de-Calais, a respective monthly average of 220,000 and 204,000 metric tons. To this production must be added that of the independent coke ovens. By purchasing British, Dutch and American coking smalls during this year, these plants were able to produce in all an average of 117,000 metric tons a month.

### Ruhr Coke Receipts Slowly Increasing

Since the occupation there have been some small imports of coke, which have been gradually declining, beginning with February and reaching the lowest level in March. A slight increase was noticed in these imports through May and June, followed by a further decline in July and a revival during August, September and October. Coke indemnity deliveries promptly ceased from the day of the occupation of the Ruhr and arrivals of indemnity coke under the occupation in February, March and April were insignificant. The seizure of stocks in May brought an increase in the importation, but July saw the beginning of trouble in Germany, which was reflected in coke deliveries. Since then the situation has slightly improved, however. Shipment from stock resumed in November, and the occupied coke ovens were put into blast again, so that together receipts totaled 6600 metric tons a day, or about half the amount received prior to the occupation.

During February, March and April large quantities of coke were purchased in Great Britain, although this coke frequently is far from satisfactory. In May, June and July numerous orders were placed in the United States, but this importation could not be continued because of the poor condition in which the coke reached the consumer. It is presumed that this purchasing will not be renewed.

### Stocks of Iron Ore Are Heavy

During the war a number of the Eastern iron ore mines were destroyed. Reconstitution of coal mines is progressing actively so that exports are increasing. In January, 1923, iron ore production was higher than in the previous month, but this was suddenly lowered by 650,000 metric tons in February. Coke shortage was partly responsible as well as the cessation of purchases by Germany. Stocks are at present twice as great as the monthly production. Even with a production of 2,000,000 tons, the figures are still 1,600,000 tons below the 1913 level, the former figure comprising the basin of Thionville's production, which then belonged to Germany and which is now included in the French total production.

### Increase in Pig Iron Production Toward End of Year

In November and December of this year a marked increase was made in pig iron production, the average being more than half a million metric tons. With the occupation of the Ruhr some furnaces were blown out, because of the shortage of coke. From 513,000 tons in December, 1922, production dropped to 305,000 metric tons in February. Since then some furnaces have been blown-in and production has been increasing regularly, except for July. The latest available figure, which shows production at 514,230 metric tons for October, is several hundreds of tons above the 1913 record. Foundry iron has probably suffered the most during the year, while production of basic iron has rapidly progressed.

The steel ingot production, which was 414,600 metric tons in December, 1922, dropped to 289,787 metric tons in February of this year. Since then, with the exception of July, production has been gradually progressing, until 476,700 metric tons were reached in October. Basic steel production has been most affected by the coke shortage. Production of basic ingots, which was 255,711 metric tons in November, 1922, declined to only 153,962 metric tons in February from this low point gradually increasing, with the exception of July, to 286,338 metric tons in October. Open-hearth production, which in January was 149,650 metric tons, was only 121,241 tons in February. Since February a gradual increase each month, with a slight decline in June and July, brought it to about 180,000 metric tons in October.

Exports were considerably affected by exchange fluctuations. During the first 10 months of 1923 the United States received 18,647 metric tons of cast iron products and 5534 metric tons of rails. Shipments of rails to Brazil totaled 3562 metric tons. Imports of iron ore have been increasing slightly as a result of development of mining in Algeria and Tunis. Pig iron importation increased about 1500 metric tons over last year's figures, and there was an increase in the tonnage of wire rods and hoops imported. In most other products the importations for 1923 were lower than in 1922, particularly in blooms, billets, bars, all grades of sheets and rails. While exports of iron ore have diminished as a result of Germany having ceased to import iron ore and pig iron since the occupation, exports in other lines have increased considerably as a result of Germany's inability to export and the depreciation of the franc in exchange.

### Practically No Unemployment and Few Strikes

The workers, not only in France but also in Belgium and Luxemburg, have not felt the result of the coke shortage that prevailed throughout the year as keenly as might have been expected. Working hours were reduced in France, in some cases drastically, but as deliveries of indemnity coke under the occupation began to improve as the year progressed, unemployment diminished until today it is practically at a

minimum. Increases in the cost of living caused by the pressure of depreciating exchange and high prices of coal necessitated increases in the wages of metal workers twice during the year, but these changes were moderate and granted without strikes. Belgian works have been forced during the year to make more and considerably greater wage increases than French plants, but when average wages are compared on the basis of dollar exchange, it is found that the higher exchange value of the French franc brings remuneration in the two countries to practically the same level.

Strikes in French industry, particularly among iron and steel plants, were insignificant. The single exception was the activity among the miners, where strikes were called in February and again in November, the latter strike largely communistic. Both strikes were settled in a few days.

For 1924, French industry is looking forward to increased production, lower prices and a revival of competition in export by the return of Germany to world trade. To a great extent, also, political developments are expected to control the present fairly active business in sales of semi-finished material to the United Kingdom finishing mills.

# Belgian Exports, Aided by Depreciated Franc, Improved—Large Imports of British Coal and Coke Met Coke Shortage

THE year 1923 began under most difficult circumstances for Belgian industry, caused on the one hand by the persistence of the political situation brought about by the war and on the other hand by the uncertainty of what might result from the occupation of the Ruhr. Throughout its course the year has been marked by great uncertainty as to prices and a succession of abnormal situations. Industry in general and principally the metal industries, have been dull, always meeting with the serious obstacle of unsteadiness in foreign exchange. At the end of 1922, it was felt that the Belgian franc had depreciated to exceedingly low levels, with the dollar worth 15 fr. (1 fr., 6.66c) but as 1923 draws to a close, the value in exchange of the franc is 21.60 to the dollar (4.63c), after having declined in August to 22.50 fr. to the dollar (4.44c).

By the middle of January, the first firmness appeared in the market with increases of prices caused by the occupation of the Ruhr. Disturbances in the occupied area were anticipated in view of the curtailment of operations, caused by the attitude of Ruhr industry. This situation produced a heavy demand both from domestic sources and foreign customers, the upward trend becoming so decisive that by the end of January producers were no longer disposed to quote.

### British Coal Substitutes For Ruhr Deliveries

Coke prices were extremely high. From the beginning of the year, the coal and coke markets were firm. Industrial coal was in great demand as well as coke. Prices were high, reflecting the high wages being paid. In some cases, wages showed 400 to 500 per cent increases from the rates prevailing immediately following the armistice. The market was at once influenced by the situation in the Ruhr, especially the price of coking coal.

In general, Belgium imports coal. Prior to the war, imports totaled about 8,000,000 metric tons, and exports were about 4,000,000 tons. Among the imported coals were highly volatile, long burning and gas coals. Germany was the principal source of supply for coking coals, so that during 1911, 1912 and 1913, Belgium received from Germany about 400,000 tons per month against 175,000 tons per month from the United Kingdom. This year the average figures for the first six months show imports of about 400,000 tons from England, compared with receipts of about 55,000 metric tons a month from Germany. While Germany was called upon to supply to Belgium in 1922 for reparations, a total of 3,161,325 metric tons of fuel, actual deliveries were 2,864,617 metric tons, a deficit of 296,700 metric tons.

From these receipts of German coal, coke makers received about 83,000 metric tons a month. The total tonnage of coal used was 384,840 metric tons, of which 171,270 tons was domestic coal, so that it is evident that a large part had to be obtained from other countries, principally Great Britain. Consequently, prices for British coal were of great importance and had considerable influence on the iron market. From the beginning of February, arrivals from the Ruhr entirely ceased and prices for Belgian gas and coking coals increased to unexpected proportions. Probably in time this peculiar situation will change for among the coal pits newly worked out in the Campine, large quantities of coal suitable for coke ovens have been extracted.

The year was filled with uncertainties and prosperity depended greatly upon the tonnages received from the Ruhr, which were not by any means so large as expected, so that importation from England had to be increased throughout the year. Even British coke was imported in large quantities and prices as high as 350 fr. per metric ton were paid by steel works in some cases.

### Coke Shortage Fairly Well Met

The situation was not so bad, however, as in Lorraine and Luxemburg. In these districts, furnaces were blown out, while Belgian furnaces were only forced to curtail production during the worst periods of coke shortage. The market by the end of January was dull and only small spot business was being done. Exchange rates were still rising, the franc being quoted at 19.125 to the dollar, in contrast to 15 fr. at the end of 1922. Export trade had practically ceased and quotations by mills no longer adhered to the usual bases and differentials. For some time, it was hoped that some amicable arrangement might be made with Germany, so that coke shipments would resume on their former scale. In all February, reparations coke receipts from the Ruhr totaled only about 1000 tons and were but little better in March. In May, Ruhr deliveries passed the 100,000 ton mark and in June reached the peak for nine months of this year of 171,467 metric tons, which was not again approached until September when 170,059 metric tons was obtained.

During February prices for iron and steel continued to climb higher, as a result of higher costs of coke and increases in wages. In accordance with an agreement between employers and the labor syndicates, wages were kept fluctuating with the index numbers of the cost of living as reported monthly by the Government. The market rapidly became more and more chaotic with a wide range of prices quoted.

### British Iron Found Ready Market in Belgium

With prices continuing strong in March, some export business was done. At this time there was a heavy importation of British and Scotch foundry iron that, even at increased prices, found a ready market in Belgium. Quotations on this iron varied between 125s and 130s, c.i.f. Antwerp, which was about equal to 500 fr. per metric ton, the price of the domestic product. Later the depreciation of the pound sterling facilitated this importation, for at 132s for Scotch No. 3 foundry, business was still possible. Sales at 132s represented about 580 fr., or $30.50 per metric ton. Belgian pig iron was practically unobtainable at that time, the lowest price quoted for available tonnages being a minimum of 600 fr. By the end of March prices for Scotch foundry had been increased to 134s, but with the still lower rate of exchange on the pound sterling, this price only equalled about 550 fr. per metric ton. Middlesbrough foundry iron was then quoted at 135s, c.i.f., so that imports were limited to

the Scotch grade. British hematite was sold at this time at 134s or 550 fr., against 600 fr. for Belgian hematite. With these high prices ruling, American offers of pig iron were on the market. The American quotation of $37 per ton delivered, for No. 1X foundry was, however, found to be too high and no business was transacted, especially as the American sellers could offer only May-June delivery.

British hematite, both from the West and East coast, has been imported throughout the year. Belgian production of hematite is limited and it is only on rare occasions that the British product meets Belgian competition. Demand for Scotch and Middlesbrough foundry entirely disappeared about the end of April when prices for Belgian foundry iron were reduced to 520 to 530 fr. per metric ton, the British product at the current rate of exchange costing 132s, c.i.f. Antwerp, or 536 fr. delivered consumers' works.

### Market Declines in Second Quarter

Prices continued to decline until by the end of April, quotations were largely nominal, export business had practically disappeared and the market generally showed a decided weakness. Labor scarcity and high wages began to develop and in May came the railroad strike and increased coke prices. Iron and steel prices, however, continued to decline and quotations as low as 600 fr. per ton were made on bars and shapes. At this time of depression, the Government ordered 12,000 tons of 110-lb. rails from four of the largest mills and by July more orders were appearing and export business began to recover. Prices increased and were fairly well maintained. Large export business began to be done, especially in rails. The franc further depreciated, rendering prices still firmer. Billets became scarce and mills began to import raw material from foreign sources, particularly from Luxemburg and France. Blooms were quoted at 550 fr. and billets at 600 fr. per metric ton. During July, prices continued high, while by contrast, in France, the market was calm and furnaces were blown out in both Britain and the United States.

### Active Export Trade and Higher Prices in July

The Belgian market, however, continued to climb steadily. In addition more furnaces went into blast bringing the number to 38 in July. Demand was active and satisfactory export business was transacted. Mills were booking for from three to four months in advance.

In September a decline set in, except in the case of billets and blooms, which held firm. Wage increases continued in company with weaker prices, caused by a depreciating franc. Works, however, were still booking heavy business, particularly for export. Not until the end of October did a genuine dull period set in with further price reductions.

At the close of the year, with the possibility of definite settlement in the Ruhr, accompanied by a return of German competition, prices are being maintained with difficulty. New business is not abundant, but works are fairly well booked ahead with business from Great Britain, South American markets, Japan and the United States (California). Semi-finished products and rails were the products in greatest demand during the year.

### Ruhr Settlement Seems Expected

Wages and raw materials, such as coal and coke, are high, so that in the new year no extensive or sudden reduction of Belgian prices seems imminent. The British election result, eliminating the danger of a tariff, has been viewed with satisfaction, as the United Kingdom is one of the best customers of Belgium in semi-finished materials. But there is still considerable doubt as to what the future may hold in store, as a result of these same elections. Settlement of the Ruhr situation seems expected and a return of German competition eventually, as Ruhr production again mounts toward capacity.

# By-Product Coke Capacity Increasing

## Ovens Capable of Producing Nearly Fifty Million Tons, of Which Over 80 Per Cent Is to Meet Demand of Blast Furnaces

AS of Jan. 1 there were standing or in course of construction in the United States by-product coke plants with a total of 11,872 ovens, having a coal carbonizing capacity of 67,973,550 tons, capable of producing 49,764,750 tons of coke. One year ago, there was by-product coke oven capacity for carbonizing 65,380,200 tons of coal with an indicated yield of 47,869,000 tons of coke, the number of ovens built or being built at that time being 11,931. Last year, therefore, saw a decrease in the number of ovens of 59, but a gain in the coal carbonizing capacity of 2,593,350 tons and in the indicated coke yield of 1,895,750 tons.

In 1923, the plant of the Weirton Steel Co., Weirton, W. Va., comprising 37 ovens was completed and placed in operation, but the addition to the Clairton, Pa., plant of the Carnegie Steel Co., consisting of 366 ovens, reported as building a year ago, was still in that state at the beginning of this year. The Weirton plant, therefore, provides the only accretion to actual production during the year. Last year saw the dismantling of 100 ovens by the Camden Coke Co., Camden, N. J., of a like number by the Hamilton Otto Coke Co., Kokotto (Hamilton), Ohio, and 188 ovens at the Lackawanna plant of the Bethlehem Steel Co. The Camden and Hamilton plants had been idle for some time. The Lackawanna ovens were razed to make room for the 114 new ovens now under construction. This abandoned capacity was capable of producing 808,300 tons yearly.

The beginning of the new year finds 695 ovens in course of construction. These installations include 366 ovens for the Carnegie Steel Co. at Clairton, Pa.; 11 for the Battle Creek Gas Co., Battle Creek, Mich.; 33 for the Columbia Steel Corporation, Provo, Utah; 61 for the Republic Iron & Steel Co., Youngstown, Ohio; 19 for the Consumers' Power Co., Zilwaukee, Mich.; 114 for the Bethlehem Steel Co., at Lackawanna, N. Y.; 47 for the Trumbull-Cliffs Furnace Co., Warren, Ohio; 23 for the Diamond Alkali Co., Alkali, Ohio, and 21 for the Utica Gas & Electric Co., Utica, N. Y. These are all Koppers Becker ovens and they have a combined coke capacity of 5,295,850 tons. Deducting these 695 ovens and the 24 ovens of the Penn Iron & Steel Co., Dover, Ohio, and 120 ovens of the Allegheny By-Products Coke Co., Glassport, Pa., which are not in operation, the number of ovens in actual production as of Jan. 1, 1924, was 11,033 and deducting the production of these ovens the actual coke capacity of that date was 43,980,000 tons. One year ago the number of ovens in active operation was 11,184, with a coke capacity of 44,006,000 tons. The past year's gain in capacity, therefore, has been more potential than actual, but this year will see much of the potential become producing capacity.

THE IRON AGE this year presents the table of by-product coke plant capacity in somewhat different form than in other years. Plants built primarily for the purpose of serving blast furnaces are segregated from those for which the production of gas was the principal objective. The latter are designated commercial plants. Strictly speaking all plants are commercial, since the steel companies market some of the coke and gas produced and no small part of the other by-product is sold

outside rather than consumed in the plant or plants served. The new form of table is of interest to the iron and steel industry, since it details clearly the important part played by that industry in the establishment of the by-product coke industry. As will be observed, no less than 9466 of the 11,872 ovens built or in process of construction find the reason for their existence in direct demand for coke for pig iron production. These ovens account roughly for more than 80 per cent of the coke producing capacity of the country.

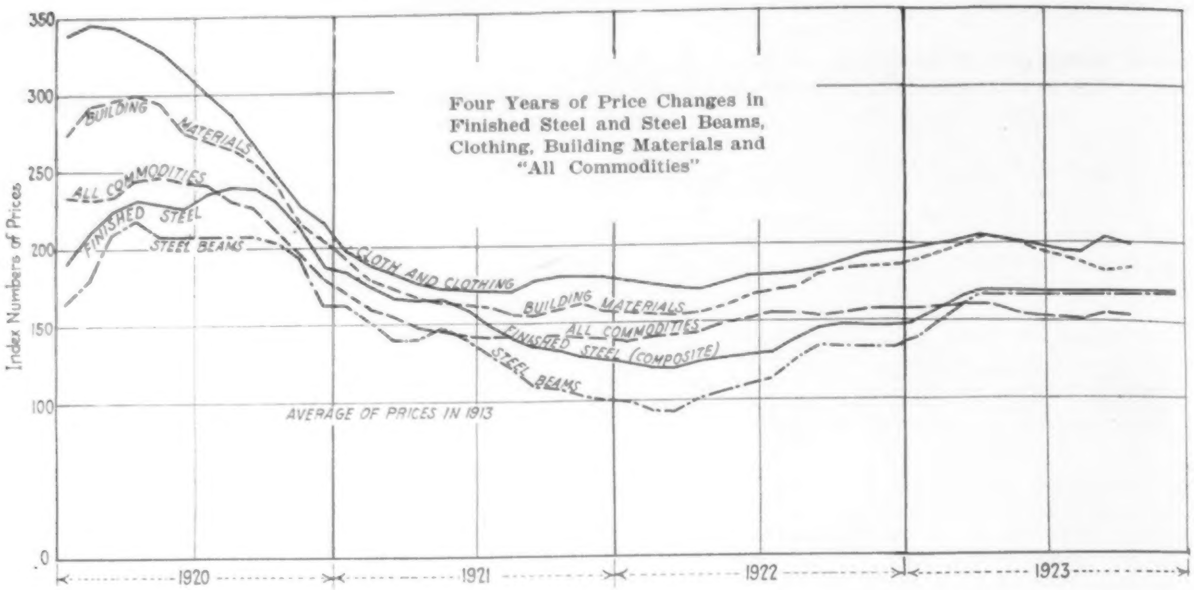
IRON AND STEEL COMPANY PLANTS

| Name Location | No. of Ovens | Kind of Oven | Annual Capacity, Net Tons: Coal | Annual Capacity, Net Tons: Coke |
|---|---|---|---|---|
| American Manganese Mfg. Co., Dunbar, Pa | 110 | Semet-Solvay | 240,000 | 173,000 |
| American Steel & Wire Co., Cleveland | 180 | Koppers | 1,080,000 | 750,000 |
| Ashland By-Product Coke Co., Ashland, Ky | 108 | Semet-Solvay | 864,000 | 648,000 |
| Bethlehem Steel Co., Sparrows Point, Md | 360 | Koppers | 2,190,000 | 1,576,000 |
| Lackawanna, N. Y. | 456 | 282 Rothberg | 663,800 | 491,700 |
| | | 60 Semet-Solvay | | |
| | | †114 Koppers | 1,200,000 | 900,000 |
| Bethlehem, Pa. | 424 | Koppers | 2,400,000 | 1,920,000 |
| Lebanon, Pa. | 90 | Semet-Solvay | 640,000 | 465,000 |
| Steelton, Pa. | 180 | 120 Semet-Solvay | 976,000 | 621,000 |
| | | 60 Koppers | | |
| Johnstown, Pa. | | | | |
| Franklin | 492 | 210 United-Otto | 1,829,000 | 1,226,000 |
| | | 92 Koppers | | |
| | | 190 Cambria-Belgian | | |
| Rosedale | 208 | 120 Cambria-Belgian | 1,278,000 | 895,000 |
| | | 88 Semet-Solvay | | |
| Carnegie Steel Co., Clairton, Pa | 1,134 | †366 Koppers | 8,085,000 | 6,350,000 |
| Farrell, Pa. | 212 | United-Otto | 830,000 | 531,000 |
| Central Iron & Coal Co., Holt, Ala | 60 | Semet-Solvay | 290,000 | 220,000 |
| Colorado Fuel & Iron Co., Minnequa, Colo | 120 | Koppers | 720,000 | 550,000 |
| Columbia Steel Corporation, Provo, Utah | 33 | †33 Koppers | 365,000 | 263,750 |
| Donner-Union Coke Corporation, Buffalo | 150 | Koppers | 1,000,000 | 690,000 |
| Ford Motor Co., Dearborn, Mich | 120 | Semet-Solvay | 864,000 | 622,000 |
| Gulf States Steel Co., Alabama City, Ala | 37 | Koppers | 237,000 | 175,000 |
| Illinois Steel Co., Gary, Ind | 700 | Koppers | 4,400,000 | 3,480,000 |
| Joliet, Ill. | 280 | Koppers | 1,500,000 | 1,200,000 |
| Inland Steel Co., Indiana Harbor, Ind | 130 | Koppers | 890,000 | 666,000 |
| International Harvester Co., South Chicago | 88 | Wilputte | 578,000 | 376,000 |
| Iron By-Product Coke Co., Ironton, Ohio | 60 | Semet-Solvay | 432,000 | 311,000 |
| Jones & Laughlin Steel Corporation, Pittsburgh | 300 | Koppers | 2,000,000 | 1,300,000 |
| McKinney Steel Co., Cleveland | 204 | Koppers | 1,300,000 | 910,000 |
| Minnesota Steel Co., Duluth, Minn | 90 | Koppers | 600,000 | 450,000 |
| National Tube Co., Lorain, Ohio | 208 | Koppers | 1,350,000 | 945,000 |
| Benwood, W. Va | 120 | Semet-Solvay | 270,000 | 189,000 |
| Otis Steel Co., Cleveland | 100 | Semet-Solvay | 450,000 | 337,500 |
| *Penn Iron & Steel Co., Dover, Ohio | 24 | Roberts | 144,000 | 100,000 |
| Pittsburgh Crucible Steel Co., Midland, Pa | 100 | Koppers | 667,000 | 435,000 |
| Portsmouth By-Product Coke Co., Portsmouth, Ohio | 108 | Semet-Solvay | 770,000 | 559,000 |
| Rainey-Wood Coke Co., Swedeland, Pa | 110 | Koppers | 800,000 | 600,000 |
| Republic Iron & Steel Co., Youngstown | 204 | †61 Koppers | 1,620,000 | 1,194,000 |
| St. Louis Coke & Chemical Co., Granite City, Ill | 80 | Roberts | 400,000 | 250,000 |
| Semet-Solvay Co., Ensley, Ala | 240 | Semet-Solvay | 760,000 | 530,000 |
| Semet-Solvay Co., Buffalo | 60 | Semet-Solvay | 396,000 | 289,000 |
| Sloss-Sheffield Coal & Iron Co., Birmingham, Ala | 120 | Semet-Solvay | 864,000 | 622,000 |
| Tennessee Coal, Iron & Railroad Co., Fairfield, Ala | 434 | Koppers | 2,560,000 | 1,920,000 |
| Toledo Furnace Co., Toledo, Ohio | 94 | Koppers | 560,000 | 408,800 |
| Trumbull-Cliffs Furnace Co., Warren, Ohio | 47 | †47 Koppers | 490,000 | 367,500 |
| United Furnace Co., Canton, Ohio | 47 | Koppers | 280,000 | 204,400 |
| Weirton Steel Co., Weirton, W. Va | 37 | Koppers | 365,000 | 255,000 |
| Wheeling Steel Corporation, Follansbee, W. Va | 94 | Koppers | 610,000 | 445,000 |
| Woodward Iron Co., Woodward, Ala | 230 | 170 Koppers | 1,000,000 | 700,000 |
| | | 60 Wilputte | 330,000 | 231,000 |
| Youngstown Sheet & Tube Co., Youngstown | 390 | Koppers | 2,570,000 | 1,804,000 |
| Indiana Harbor, Ind | 120 | Semet-Solvay | 864,000 | 622,000 |
| Mayville, Wis. | 108 | United-Otto | 450,000 | 384,000 |
| Zenith Furnace Co., West Duluth, Minn | 65 | United-Otto | 160,000 | 112,000 |
| Total | 9,466 | | 56,204,200 | 41,264,650 |

COMMERCIAL OR GAS PLANTS

| Name Location | No. of Ovens | Kind of Oven | Coal | Coke |
|---|---|---|---|---|
| Alabama By-Products Corporation, Birmingham, Ala. | 75 | Koppers | 502,000 | 352,000 |
| *Allegheny By-Products Coke Co., Glassport, Pa | 120 | United-Otto | 260,000 | 182,000 |
| Battle Creek Gas Co., Battle Creek, Mich | 11 | †11 Koppers | 54,750 | 41,100 |
| By-Products Coke Corporation, South Chicago | 280 | Semet-Solvay | 1,300,000 | 975,000 |
| Camden Coke Co., Camden, N. J | 37 | Koppers | 230,000 | 164,000 |
| Central Indiana Gas Co., Muncie, Ind | 22 | Klonne | 40,000 | 28,000 |
| Chattanooga Gas & Coke Co., Alton Park, Tenn | 24 | Semet-Solvay | 175,000 | 125,000 |
| Chicago By-Products Coke Co., Chicago | 105 | Koppers | 722,000 | 482,000 |
| Citizens Gas Co., Langsdale, Ind | 41 | Semet-Solvay | 255,000 | 182,900 |
| Citizens Gas Co., Prospect, Ind | 140 | 100 United-Otto | 567,000 | 409,400 |
| | | 40 Wilputte | | |
| Coal Products Mfg. Co., Joliet, Ill | 53 | 35 Koppers | 340,000 | 288,000 |
| | | 18 Wilputte | | |
| Consumers Power Co., Zilwaukee, Mich | 19 | †19 Koppers | 73,000 | 54,750 |
| Diamond Alkali Co., Alkali, Ohio | 23 | †23 Koppers | 200,000 | 150,000 |
| Domestic Coke Corporation, Fairmont, W. Va | 60 | Koppers | 400,000 | 260,000 |
| Empire Coke Co., Geneva, N. Y | 46 | Semet-Solvay | 146,000 | 102,000 |
| Indiana Gas & Coke Co., Terre Haute, Ind | 60 | 30 Gas Machine | 292,000 | 205,000 |
| | | 30 Koppers | | |
| Laclede Gas Light Co., St. Louis | 64 | 56 Koppers | 320,000 | 240,000 |
| | | 8 Piette | 40,000 | 26,000 |
| Linton Gas Co., Linton, Ind | 3 | Gas Machine | 15,000 | 9,300 |
| Michigan Alkali Co., Wyandotte, Mich | 54 | United-Otto | 169,000 | 118,400 |
| Milwaukee Coke & Gas Co., Milwaukee, Wis | 150 | 50 Semet-Solvay | 275,000 | 193,000 |
| | | 100 Koppers | 667,000 | 467,000 |
| Minnesota By-Products Coke Co., St. Paul, Minn | 65 | Koppers | 400,000 | 300,000 |
| New England Fuel & Trans. Co., Everett, Mass | 400 | United-Otto | 650,000 | 455,000 |
| North Shore Gas Co., Waukegan, Ill | 13 | Semet-Solvay | 55,000 | 38,500 |
| Philadelphia Suburban Gas & Electric Co., Chester, Pa. | 40 | Semet-Solvay | 667,000 | 435,000 |
| Providence Gas Co., Sassafras Point, R. I | 40 | Koppers | 240,000 | 165,000 |
| Seaboard By-Products Coke Co., Kearny, N. J | 165 | Koppers | 1,200,000 | 900,000 |
| Seattle Lighting Co., Seattle, Wash | 20 | Klonne | 24,000 | 18,000 |
| Semet-Solvay Co., Detroit | 215 | Semet-Solvay | 1,343,000 | 1,009,000 |
| The Solvay Process Co., Syracuse, N. Y | 40 | Semet-Solvay | 65,000 | 45,000 |
| Utica Gas & Electric Co., Utica, N. Y | 21 | †21 Koppers | 105,000 | 78,750 |
| Total | 2,406 | | 11,791,750 | 8,499,100 |
| Grand total | 11,872 | | 67,973,550 | 49,764,750 |

*Not in operation. †Building.




# Prices of Iron and Steel and Other Products

## Analysis of Basic Facts Shows Metals Lower Than Many Other Commodities—Changes in Past Year Indicated

BY SIDNEY G. KOON

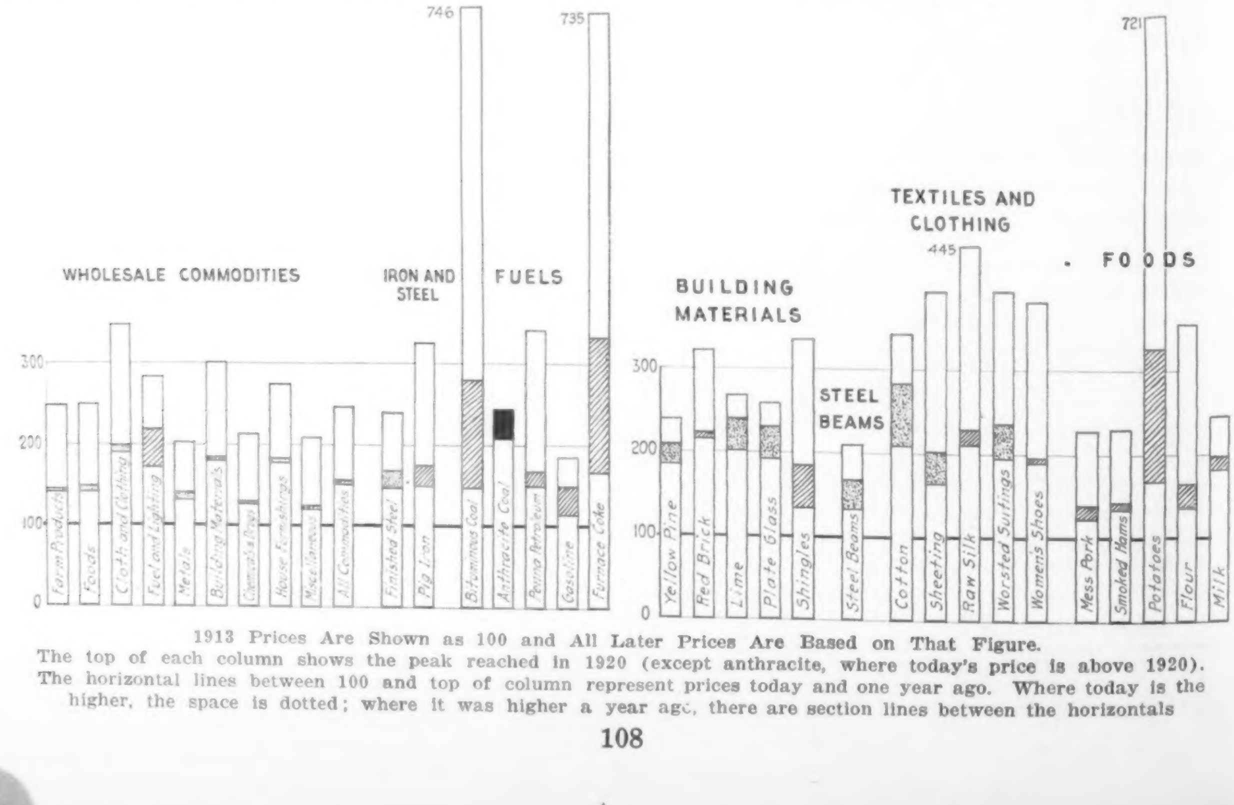
TWO years ago THE IRON AGE published an article under the above title, in which it was pointed out that finished steel was lower in comparison with the prices of other products than almost any other major item. In other words, it was closer to the 1913 price level than other principal commodities. Last year another article on the same subject was published, showing that the condition still obtained, and that the iron and steel price level, together with that of metals generally, was below the level of nearly all other commodities.

Steel is higher today than it was a year ago; pig iron is considerably lower. Steel represents an advance of 67 per cent above the 1913 price, against only 47 per cent last year, while pig iron is 49 per cent above 1913, against 75 per cent a year ago.

Compared with building materials, clothing, and a number of other important materials, however, both steel and iron are relatively low in price. It is only when we come to examine food prices, petroleum, etc., that we find general groups of articles lower than are iron and steel.

Two diagrams are shown, in one of which the course of prices of a series of specific articles is traced, these covering five items of foods, five of textiles, five of building materials and five of fuels, as compared with THE IRON AGE composite prices of finished steel and pig iron, the price of steel beams and the wholesale commodity prices reported monthly by the United States Bureau of Labor Statistics.

(*Concluded on page* 138)




1913 Prices Are Shown as 100 and All Later Prices Are Based on That Figure. The top of each column shows the peak reached in 1920 (except anthracite, where today's price is above 1920). The horizontal lines between 100 and top of column represent prices today and one year ago. Where today is the higher, the space is dotted; where it was higher a year ago, there are section lines between the horizontals

# New Capacity in Iron and Steel Works

## Open-Hearth Capacity Completed Last Year Largest Since the War—Projected Capacity Light—No Blast Furnaces Added in 1923—New Electric Furnaces

**LAST year, in new iron and steel works construction, was exceptional for two reasons: More new open-hearth capacity was installed than in any other year since the war and, for the first year in many, no new blast furnaces were completed. A year ago attention was called to the large gain in new capacity projected for 1923; the year has fulfilled this expectation and presents a strong contrast to 1922 when a new low record since 1911 was made. New open-hearth capacity projected for 1924 is not heavy but is slightly larger than the capacity added in 1922.**

**While no new blast furnaces were completed in 1923, there are five new ones projected or under construction. This compares with only two planned for completion in 1923 but not finished. In the last three years the additions to blast furnace capacity have been strikingly few, the total for 1921, 1922 and 1923 having been but three—one in 1921 and two in 1922. The 1923 record is the poorest in 27 years.**

**The war years, of course, hold the record for both pig iron and steel. In new open-hearth or steel making capacity completed in any year, 1917 stands first with 97 furnaces finished, having an estimated capacity of 4,326,500 gross tons per year. In new capacity projected or under way the record was 72 furnaces in 1916, having an estimated capacity of 4,515,000 tons per year. For 1923 the estimate is 875,000 tons annual capacity completed and 350,000 tons projected for completion in 1924. The maximum records in pig iron were 14 furnaces completed in 1917 and 25 furnaces under way in 1916. The analysis this year shows no furnaces completed in 1923 and five projected for completion or starting in 1924.**

**Additions to electric steel furnace capacity are included in this review this year. They are equal to any year since the war in number of furnaces.**

## Additions to Pig Iron, Steel and Rolling Mill Capacity

REPORTS from blast furnace, steel and rolling mill companies as well as a few steel foundries furnish the following facts regarding 1923 and work planned for 1924:

### New Open-Hearth Capacity in 1923

New open-hearth capacity completed in 1923 was the largest of any year since the war. Furnaces completed, and either operating or ready to operate, represent a capacity of about 875,000 gross tons, greatly exceeding the record for 1922 of only 227,500 tons, which was the smallest since 1911. The 1923 additions include 19 furnaces, compared with 8 in 1922. The distribution last year was as follows:

*New Open-Hearth Furnaces Completed in 1923*

| | No. of Furnaces | Annual Capacity Gross Tons |
|---|---|---|
| Independent companies | 19 | 875,000† |
| United States Steel Corporation. | 0* | ...... |
| Total | 19 | 875,000 |

The additions to open-hearth capacity in 1923 were made by the following companies:

Bethlehem Steel Corporation, Sparrows Point plant., Md., four 100-ton stationary and one 200-ton tilting furnaces; Otis Steel Co., Cleveland, four 100-ton furnaces; Wisconsin Steel Co. (International Harvester Co.), Chicago, five 100-ton furnaces; Columbia Steel Corporation, Pittsburg plant, Pittsburg, Cal., two 75-ton furnaces; Ohio Steel Foundry, Lima, Ohio, one 20-ton furnace; Riverside Steel Castings Co., Newark, N. J., one 10-ton furnace; Eastern Steel Castings, Newark, N. J., one 8-ton furnace and the additions by the Steel Corporation noted above.

The additions since the war, according to compilations made each year by THE IRON AGE, have been as follows:

| | No. of Furnaces | Annual Capacity Gross Tons |
|---|---|---|
| 1919 | 9 | 625,000 |
| 1920 | 20 | 675,000 |
| 1921 | 8 | 247,500 |
| 1922 | 8 | 227,500 |
| 1923 | 19 | 875,000 |

*A 1300-ton hot metal mixer was put in at the New Castle works of the Carnegie Steel Co. and a 300-ton mixer at the South works of the Illinois Steel Co.

†About 25,000 tons of this represent 3 furnaces for steel castings.

The largest number ever completed in one year was 103 furnaces in 1916. In capacity the record was 4,326,500 tons for 97 furnaces in 1917.

### Open-Hearth Construction for 1924

For completion probably in 1924 there are 7 furnaces projected or under way. This compares with 17 in 1923, with 6 in 1922, with 15 in 1921 and with 22 in 1920. The largest number ever projected for one year was 91 in 1916. The estimated capacity of the 7 furnaces which may be added during 1924 is 350,000 tons, as compared with 819,000 tons for the 17 furnaces in 1923, and with 217,500 tons for the 6 furnaces scheduled for 1922—the lowest projected capacity on record. The largest contemplated addition during peace years was 3,100,000 tons in 1913 for 88 furnaces.

New installations contemplated for 1924 are scheduled for the following companies:

Carnegie Steel Co., Edgar Thompson works, two 100-ton furnaces; Inland Steel Co., Chicago, four 100-ton furnaces and Republic Iron & Steel Co., Youngstown, Ohio, one 70-ton furnace.

Several companies rebuilt last year certain furnaces and are planning similar work for this year.

Expressed in the form of a table, the proposed new open-hearth capacity is as follows:

*New Open-Hearth Furnaces Under Construction for 1924*

| | No. of Furnaces | Annual Capacity Gross Tons |
|---|---|---|
| Independent companies | 5 | 250,000 |
| United States Steel Corporation.. | 2 | 100,000 |
| Total | 7 | 350,000 |

### New Blast Furnace Construction

No additions to blast furnace capacity were made in 1923, which is the first instance in many years. In 1914 and in 1921 only one furnace was added and in 1922 only two were completed. Witherbee, Sherman & Co.'s new furnace at Port Henry, N. Y., was actually finished in 1922 but not blown in until early in 1923. The new furnace of the Hamilton Furnace Co., Hamilton, Ohio, reported as under construction in 1923, is still uncompleted.

The record in new furnaces completed in any one year was 9 in 1912 and the record in those projected for

any one year was 25 in 1917. Additions to blast furnace capacity recently have been very few. Only 3 furnaces were actually constructed in 1921 and 1922 and only 5 have been projected in 1921, 1922 and 1923.

At the beginning of 1924 there were 5 blast furnaces projected or actually under construction. The following table gives the details:

| Company | Under Construction or Projected |
|---|---|
| Hamilton Furnace Co., Hamilton, Ohio | 1 |
| St. Louis Coke & Iron Co., Granite City, Ill | 1 |
| Columbia Steel Corporation, Ironton, Utah | 1 |
| Central Steel Co., Massillon, Ohio | 1 |
| Youngstown Sheet & Tube Co., Indiana Harbor (Ind.) plant | 1 |
| Total | 5* |

*None completed in 1923

The estimated capacity of these 5 furnaces is about 900,000 tons per year.

Several companies rebuilt last year a number of their blast furnaces, enlarging their capacity in some cases. This is particularly true of the Steel Corporation.

Details of the companies' reports of new construction completed or planned are as follows:

## The Steel Corporation

New construction completed during 1923 and that under way as of Jan. 1, 1924, by subsidiary manufacturing companies of United States Steel Corporation, is as follows:

### Carnegie Steel Co.

*Completed*

Duquesne Works: Reconstruction of two 75-ton furnaces at open-hearth plant No. 2; improved manipulator for 40 in. blooming mill and steam locomotive crane and grab bucket.

Homestead Works: New charging floors, two charging machines and strengthening building at open-hearth plant No. 1; four charging machines for open-hearth plant No. 2; motor-driven tilting tables for 140-in. plate mill, and a 20,000,000 gal. centrifugal pump with motor drive in the main pump house.

Schoen Steel Wheel Works: Wheel manipulator for mill No. 1, and two vertical car wheel turning and facing lathes for mill No. 1.

New Castle Works: 1300-ton hot metal mixer and extension to mixer building.

*Under Way*

Edgar Thomson Works: Two additional furnaces at open-hearth plant No. 1; 1000-ton hot metal mixer for Bessemer metal in open-hearth plant No. 1; hot metal elevated railroad from blast furnace to Bessemer and open-hearth departments; equipping finishing end of No. 1 rail mill for rolling and handling sheet bars and new boiler house, 18,000-hp. boilers and auxiliary equipment.

Duquesne Works: Reconstruction of blast furnace No. 1 and stock yard; rebuilding four 75-ton furnaces at open-hearth plant No. 2; shipping building at 40-in. blooming mill.

Homestead Works: Two 125-ton electric overhead traveling cranes and rearranging equipment at north end of open-hearth plant No. 2 building; modern mill tables and manipulator with scale removing equipment, at 30-in. slabbing mill, and eight 834-hp. boilers and auxiliary equipment at 140-in. plate mill with steam line to 48-in. plate mill.

Carrie Furnaces: Six turbo blowers with equipment at blast furnaces Nos. 1 to 5, and three 110-hp. gas fired boilers at blast furnaces Nos. 1, 2 and 5.

Lucy Furnaces: One pair blowing engines.

Isabella Furnaces: 10-ton ore bridge and additions to ore stocking equipment.

Mingo Works: Boiler house and feed water purifying plant and coke unloading dock including power station.

New Castle Works: New boiler house, 7700-hp. boilers and coal storing and handling facilities.

Ohio Works: 3000-kw. electric generator and gas engine.

Farrell Works: Rebuilding three furnaces at open-hearth plant.

Clairton Steel Works: New boiler plants for steel works and blast furnaces, including boiler feedwater purifying plant.

Clairton By-Product Coke Works: 366 additional by-product coke ovens, with facilities for tar and ammonium sulphate recovery, benzol plant and gas booster station.

### Illinois Steel Co.

*Completed*

South Works: 300-ton hot metal mixer at No. 2 open-hearth plant and electric motor drive for 90-in. plate mill.

*Under Way*

South Works: Improvements to slabbing mill and main slabbing mill engine.

Joliet Works: Remodeling boiler house and modernizing boiler equipment at rod mills.

### Minnesota Steel Co.

*Completed*

Duluth Works: Rod and wire mill.

*Under Way*

Duluth Works: Remodeling blast furnace No. 1; two additional gas washers and enlarging washer building.

### Lorain Steel Co.

*Completed*

Johnstown Works: Shop for building steel cars for mines and industries.

*Under Way*

Johnstown Works: 3-ton Heroult electric furnace in open-hearth building; flask yard including 20-ton electric overhead traveling crane.

### National Tube Co.

*Completed*

Lorain Works: Improvements to screening facilities at by-product coke plant; equipment for electro-galvanizing couplings; extension to galvanizing plant.

National Works: Wet gas cleaning plant for stoves of blast furnaces Nos. 3 and 4; equipment for upsetting and finishing 6-in. drill pipe; continuous upsetting and threading unit for lap weld mill.

*Under Way*

Gary Works: Pipe mills, consisting of five butt weld mills, four lap weld mills and one seamless mill with auxiliary departments and shops.

Lorain Works: New boiler house building, six 1500-hp. boilers and auxiliary facilities; 1000-kw. motor generator set at blast furnace blowing engine house; improvements to blast furnace No. 3; additions to four hot blast stoves of blast furnace No. 3 and one stove of blast furnace No. 4; additional blast furnace gas engine with 3300-kw. alternator.

National Works: Five hot blast stoves for blast furnaces Nos. 3 and 4.

Ellwood Works: Extension to main building, additional finishing machinery and relocating equipment at No. 1 hot mill.

### American Steel & Wire Co.

*Completed*

Cuyahoga Works: Extending annealing building and additional annealing equipment for flat rolled material.

Central Furnaces and Docks: New piers and strengthening runway of Hoover and Mason unloaders; 25-ton locomotive crane with turbo-generator set, magnet and ore bucket.

Consolidated Works: New pot annealing building, two furnaces and 10-ton electric traveling crane.

Waukegan Works: Billet conveyor in rod mill; additional patenting furnace and equipment.

Rankin Works: Enlarging baker and extending wire mill.

Worcester, North Works: Additional continuous wire drawing equipment; equipment for electro-galvanizing wire.

Worcester, South Works: Equipment for manufacture of signal bonds.

*Under Way*

Cuyahoga Works: 3-bay extension to cold rolling building and 5-ton electric traveling crane.

Newburgh Steel Works: Rebuilding No. 3 pit furnace.

Newburgh Wire Works: Modernizing and increasing capacity of pot annealing department.

By-Product Coke Works: Water cooling tower and recirculating system.

Central Furnaces and Docks: Rebuilding blast furnace A.

Salem Works: New boiler house, four 225-hp. boilers and auxiliary equipment.

De Kalb Works: Extending nail mill building and installing nail galvanizing department.

### American Sheet & Tin Plate Co.

*Completed*

Dover Works: Equipping galvanizing plant to make flux finished sheets.

Vandergrift Works: Modern heavy duty manipulator for blooming mill.

Mercer Works: Continuous annealing furnace and building.

*Under Way*

Cambridge Works: Modernizing three hot mill furnaces and stokers for four furnaces.

Dover Works: 26-in. motor-driven bar shear with approach table and piler.

Laughlin Works: 500-kw. turbo-generator.

New Castle Works: Coal handling systems at hot mill, annealing furnaces, gas producers, tin and boiler houses.

Shenango Works: 1500-kw. turbo-generator and condenser in power house; mechanical doublers and shears for thirty hot mills.

Scottdale Works: 28-in. motor-driven bar shear with approach table and piler.

Farrell Works: Mechanical doublers and shears for twenty hot mills; rebuilding four hot mill furnaces and equipping with mechanical stokers.

### Tennessee Coal, Iron & Railroad Co.

*Completed*

Ensley Works: Six 834-hp. boilers for No. 1 steam plant; pulverizing coal plant with handling and storage facilities; motor drive for 28-in. mill; new cooling towers at No. 2 power house; six cinder cars and pots for blast furnaces.

Central Water Works: 8,000,000 gal. water recovery and cooling system.

Fairfield Works: 11-in. merchant mill; third hot unit for tie plate finishing department.

*Under Way*

Ensley Works: Five 779-hp. boilers for No. 1 steam plant; turbo-blower, condenser and cooling tower for additional blowing capacity, at blast furnaces; additions to billet yard crane runway.

Fairfield Works: Steel foundry; enlargement of finishing end of structural mill.

## Bethlehem Steel Corporation

The subsidiary companies of the Bethlehem Steel Corporation report the following improvements and additions completed in 1923 and under way at the close of the year at their various plants.

### Bethlehem Plant, Bethlehem, Pa.

Completed in 1923: Addition to locomotive repair shop; new roll foundry; additional facilities for forge department, including additional steam hammers and furnaces; heating furnaces for bar mills; 20 new gas producers, new track layout and equipment for burning coke oven gas at Saucon open-hearth department; beam shear for 12-in. and 18-in. structural mills.

Under way: Track scale for blast furnaces; cupola charging equipment at ingot mold foundry.

### Steelton Plant, Steelton, Pa.

Completed in 1923: Extending gas mains to open-hearth and forge departments; additional transformer for power department.

Under way: Coal mixing, crushing and screening equipment for coke ovens; rail finishing equipment at rail mill; additional fabricating facilities at bridge shop.

### Lebanon Plant, Lebanon, and Reading, Pa.

Completed in 1923: Extension to concentrating and sintering departments; reconstruction of 10-in. mill to 10-in.–12-in. tandem mill, including extension to building, new mill drive, and extension to cooling bed; additional equipment for tool treating and tempering department; bolt, nut and rivet shops at Lebanon; additional equipment for manufacture of rivets and track bolts at Reading plant.

Under way: Enlarging blast furnaces B and G; 10 bolt headers and handling equipment for cold bolt department.

### Maryland Plant, Sparrow's Point, Md.

Completed in 1923: Erection of 100 bungalows and store building and improvements to 80 houses; installation of one 10,000-kw. turbo generator and one gas-driven electric generator; 48-in. gas line from blast furnaces to coke ovens; 19 gondola cars for yard department; installation of gas compressor and coke braize screening station at coke ovens; new stove for blast furnace D; extension to No. 1 open-hearth consisting of four stationary furnaces, crane equipment, etc.; 200-ton tilting furnace at open-hearth No. 2; 40 ingot cars for open-hearth department; improvements at 40-in. blooming mill; extension to crane runway and additional pit crane at blooming mill soaking pits; two stands of cold rolls for sheet mills; 60-in. galvanizing unit for sheet mills; motor driven lever shear for sheet mills; two tinning machines at tin mills.

Under way: 36-in. gas line from coke ovens to sheet and tin plate plants; water treating equipment for blast furnaces; one new stove for each of blast furnaces B and C; new ladle house for blast furnace department; six 130-ton ladles for open-hearth department; 18-in. edging mill for 24-in. continuous mill; table and manipulator for 24-in. continuous mill; three hearth heating furnaces for rail mill; extension to building of galvanizing department at sheet mills.

### Lackawanna Plant, Buffalo, N. Y.

Completed in 1923: Equipment at No. 1 boiler house for burning blast furnace gas; 35 side dump cars; coke screens and 15 ladle cars and two extra ladles for blast furnace department; 18 cinder cars and 42 cinder pots for open-hearth departments Nos. 1 and 2; air washer for 32-in. rail mill; electric spacing table, six electric hoists and 14 electric rivet heaters at fabricating shop No. 1.

Under way: Equipping eight boilers in boiler house No. 1 with improved gas combustion system; three roll lathes and one roll grinder for roll shop; two batteries consisting of 114 Koppers by-product coke ovens, with necessary extension to coal handling, coke screening, by-product departments and auxiliary buildings; gas lines from new coke ovens to open-hearth No. 1; new scrap breaking and reclaiming plant; two new stoves for blast furnace D; new mill, manipulator and electric drive for 40-in. blooming mill; motor generator set at No. 7 mill; shear and extension of roller line of 16-in. bar mill; motor drive for 48-in. universal plate mill; 300 houses for employees of Lackawanna plant and under construction by Bethlehem Land & Improvement Co.

### Coatesville Plant, Coatesville, Pa.

Completed in 1923; Coke screening and loading system, two cinder ladle cars, settling pond for gas washing water at blast furnaces; improvements to regenerators of No. 58 furnace, installation of ore and tar burning system at open-hearth department; press for flanging brake drums, and double compartment furnace for flanging department; roll lifting cylinders and roll scale handling equipment at No. 3 plate mill; motor drive on scarfing rolls at 22-in. skelp mill.

Under way: Two coal-fired heating furnaces with waste heat boilers at 22-in. skelp mill; motor drive for No. 3 plate mill.

### Cambria Plant, Johnstown, Pa.

Completed in 1923: Three dust collectors at electric plant boiler house, electric substation, Franklin division; 26 gondola cars; completing coke ovens at Rosedale and Franklin divisions; additional cupola and extension to dolomite burning, building, Franklin division.

Under way: 12-in. steamline from coke oven boiler house at Franklin to engine room of blast furnaces Nos. 10 and 11; additions and improvements to scrap preparing plant, Franklin division; 20 tank cars for Rosedale coke oven department; six cinder ladle trucks for blast furnaces; improvements and additions to blast furnaces Nos. B, D and G; 15 cinder cars and pots for open-hearth department; 34-in. reversing billet mill complete, including building and equipment at Franklin division.

### Mining and Other Properties

*Bethlehem-Chile Iron Mines Co., Chile.*—Under way: Fourteen 3-room dwellings; two 500-kw. generator sets; one ½-ton electric furnace in foundry; one 300-ton electric shovel; three 60-ton electric locomotives; thirty-seven 70-ton side dump cars; twenty-five 50-ton hopper bottom cars, additional mooring facilities.

*Cornwall Ore Banks Corporation, Cornwall, Pa.*—Under way: Ore hoist, hoist house, switchboard, air compressor, crusher plant and storage system; railroad to new shaft site.

## Youngstown Sheet & Tube Co.

The Youngstown Sheet & Tube Co., Youngstown, Ohio, completed last year the following construction:

East Youngstown Works: The hearth and bosh of blast furnace No. 4 was enlarged from 16-ft. to 18-ft. 6-in. in diameter to increase the capacity.

Improvements at No. 3 skelp mill, comprise a universal plate mill, electric drive and equipment. The mill is a 30-in. 2-high Mackintosh-Hemphill Co.'s latest design for making universal plates varying from 7⅞ in. to 45 in. in width, and sheared plates up to 72 in. The drive is a General Electric single unit 4000 hp. reversing motor, 80 to 135 r.p.m. with flywheel generator set and equipment. The reversing motor and generator set are cooled by individual air washers. The drive complete is housed in separate brick building. In order to supply additional heating capacity, two Chapman-Stein 3-pass continuous heating furnaces were built, each with a capacity of 300 tons per 24 hr. Three Morgan Construction Co.'s gas producers were installed to furnish gas for these furnaces. Total tonnage capacity of the new mill is 30,000 tons per month.

In boiler house No. 8 two 1505-hp. Springfield boilers, coal-fired by 14 retorts Taylor stokers were installed. A complete Bartlett and Snow coal handling installatien, 150 tons per hr. capacity, was built in conjunction with this.

Tube mill No. 10 was rebuilt along the lines of No. 11, including new bending and welding furnaces, charging machines and run-out troughs, chill rolls and a straightener, new inspection skids, scales, cooling racks, and scrap conveyors. These changes resulted in an increase in tonnage of 15 per cent.

Hubbard Works: One 10-ton Heyl and Patterson ore bridge. The ore bridge has a span of 225 ft. and is equipped with a 10-ton grab bucket capable of handling 5000 to 5500 gross tons of ore per day of 10 hr. Two 400-kw. generators were moved from the East Youngstown Works to take care of the added power requirements. The dumping trestle and ore bridge runways are of steel and reinforced concrete construction.

Iroquois Works: The lines of blast furnace No. 4 were changed. The hearth was enlarged from 14-ft. to 16-ft. diameter to give an increased production.

A new blast furnace (650 tons) is contemplated for erection in 1924 at Indiana Harbor plant; also two butt-weld pipe mills.

## Inland Steel Co.

The Inland Steel Co., Chicago, with works at Indiana Harbor, Ind., and Chicago Heights, Ill., added during 1923 a calcining plant, scrap yard shear and tables to its No. 2 open-hearth department; a new splice bar unit; a 75-ton crane in its 28-in. mill; a 15-ton crane, 32-in. mill and a new hot bed with new tables and a flying shear in its 24-in. sheet bar mill.

The company has under construction four 100-ton open-hearth furnaces; a 24-in. billet mill; a 14-in. continuous merchant mill and a new power station.

## West Leechburg Steel Co.

The West Leechburg Steel Co., Pittsburgh, recently completed a new 16-20 in. hot-strip mill having a capacity of 400 to 500 tons daily, or 10,000 to 12,000 tons monthly. This mill was described in the issue of THE IRON AGE of December 13. In connection with this mill a pickling department, 54 ft. by 160 ft., was installed equipped with mechanical type pickling tubs. During 1923 a new steel warehouse, 80 ft. by 280 ft.,

for use in connection with a cold mill finishing department was completed as well as a machine and electrical shop of steel construction, 60 ft. by 160 ft., fully equipped. To the cold-rolling equipment there has been added a 5-stand, 2-high 16-in. by 22-in. tandem cold mill, which will not be in operation until about Feb. 1, 1924.

## Wheeling Steel Corporation

Wheeling Steel Corporation, Wheeling, W. Va., completed in 1923 the following installations:

At its Portsmouth works, Portsmouth, Ohio, a Morgan continuous 10-in. rod mill of 400-ton capacity per 24 hr., having electric drive, and also a wire and nail mill in connection with the rod mill. Two Morgan gas producers were put in and two 500-hp. Connelly boilers.

At its LaBelle works, Wheeling, W. Va., one 12,000 gal per hr. capacity water softening plant, three 500-hp. boilers transferred from another plant.

At its Steubenville works, Steubenville, Ohio, one 2-high 35-in. blooming mill driven by a 4-cylinder uniflow reversing engine; one 2-high 19-in. continuous mill driven by a 4-cylinder uniflow engine and having a capacity of 2400 tons per 24 hr; two 1000-kw. generators driven by uniflow engines; two soaking pits; six R. D. Wood & Co. gas producers, and five 829-hp. Connelly boilers fired with powdered coal and blast furnace gases.

## Republic Iron & Steel Co.

Republic Iron & Steel Co., Youngstown, Ohio, is increasing its steel making capacity by the addition of another open-hearth furnace to its plant at Lansingville, bringing the total to 15 furnaces.

One of the company's blast furnaces at Haselton is being rebuilt and enlarged, and an addition to its by-product coke oven battery, which will make it self-contained as to coke supply, is nearing completion.

It is reported that the company plans to build a new bar mill during the present year and also to add a new hot metal mixer at its Bessemer plant.

## Otis Steel Co.

The Otis Steel Co., Cleveland, built an open-hearth steel plant in connection with its Riverside Works. This is virtually completed and the company plans to place it in operation this month. The new plant includes four 100-ton open-hearth furnaces, a 40-in. blooming mill and a 24-in. sheet bar mill. The semi-finished steel produced will be used in the company's finishing department. The Otis company also completed a strip mill plant at its Riverside Works last year. This is equipped with a 20-in. hot-strip mill and 20 stands of cold rolls with an annual capacity of 80,000 tons. The hot-strip mill was placed in operation during the fall and the cold rolls will be started shortly.

## Mahoning Valley Steel Co.

The Mahoning Valley Steel Co., Niles, Ohio, during 1923 erected a new furnace building, installing additional continuous pair furnaces, charging machinery, a 25-ton crane and other equipment, increasing its annual sheet making capacity to 60,000 tons.

## Timken Roller Bearing Co.

The Timken Roller Bearing Co., Canton, Ohio, last year installed a 16-in. roughing mill as an addition to its 10-in. bar mill, and a new mechanical hot bed. Further additions to its steel plant that will be made this year include a 32-in. blooming mill and soaking pits. New buildings will be erected for the mill requirements and an additional chipping building will be erected.

## United Alloy Steel Corporation

The United Alloy Steel Corporation, Canton, Ohio, has considerable construction work under way in its steel plant. New soaking pits and a preliminary warming pit, and a new gas producer are being built. Construction plans for the present year include the rebuilding of two continuous furnaces and the building of a power and boiler house.

## Newton Steel Co.

The Newton Steel Co., Youngstown, Ohio, completed and placed in operation 10 additional hot mills at its plant in Newton Falls, Ohio, during 1923, doubling its former capacity. Additional cold rolling capacity was also provided to take care of the output of the additional hot mills and an additional pickling machine.

## International Harvester Co.

The Wisconsin Steel Works of the International Harvester Co., South Chicago, Ill., has under construction five 100-ton open-hearth furnaces which it is expected will be in operation late in January or early in February. Other work under way includes a new blooming mill with the necessary soaking pits and a 90-ft. extension to the ore unloading slip.

## National Enameling & Stamping Co.

The National Enameling & Stamping Co., Granite City, Ill., last year installed a new plate mill, a 72-in. jobbing mill and six new sheet mills as well as a galvanizing sheet department. The addition of these mills, it is estimated, involved an expenditure of approximately $1,000,000 and added 5,000 tons of sheet steel output per month to the present capacity of 17,000 tons.

## John A. Roebling's Sons Co.

John A. Roebling's Sons Co., Trenton, N. J., at its Roebling, N. J., plant completed in 1923 a rod mill for specialty work, rolling rounds and flats, both steel and copper. It consists of one continuous heating furnace, oil fired; one stand of 18-in. 3-high roughing rolls; 11 continuous and looping stands, 14 in. to 10 in., with automatic reels, conveyor and crane for loading directly into standard railroad cars. This mill was described in THE IRON AGE, Dec. 6, 1923. There was also erected a manufacturing building for miscellaneous products, 220 ft. by 240 ft., in saw tooth design of steel and brick; an addition to the tempering shop, 75 ft. by 400 ft., with cranes for handling and storing rods. Additional drying ovens for the cleaning houses and additional galvanizing rigs for large sizes of wire. A locomotive house of steel, brick and glass was also built. Wire mill No. 3 was fully equipped with block stripping devices. Three billet and eight ingot heating furnaces were changed from producer gas to fuel oil, completing the replacement of all remaining producers by oil.

In the village of Roebling, N. J., 30 brick houses were completed, bringing the total to 752. A fully equipped hospital was added and a large amount of concrete and asphalt paving completed, together with concrete sidewalks and curbings.

At the company's Trenton, N. J., plant, an additional copper wire drawing mill equipped with continuous machines was 80 per cent completed.

At the Upper Works and the Buckthorn Works two turbine power houses have been connected by 3500 ft. of underground conduit system, and there is under way the construction of two electric sub-stations, one at Trenton and one at Roebling, for auxiliary purchased power of a total of 7000 kw.

## Scullin Steel Co.

The Scullin Steel Co., St. Louis, added several buildings during 1923 and increased the size of the hot bed on the 24-in. mill, increasing the capacity to 8000 tons per month.

## Phoenix Iron Co.

The Phoenix Iron Co., Phoenixville, Pa., is changing two of its finishing mills from steam engine to motor drive. The equipment for the 24-in. mill drive consists of a 2500-hp. alternating current motor, direct connected to a 2500-kw. direct current generator which generates current for a 3000-hp. direct current reversing motor which drives the mill by means of a herring-

bone gear to reduce the motor speed. The type of equipment used on this installation will permit ready speed adjustment from zero to 105 r.p.m. on the mill. The speed between zero and 70 r.p.m. will be obtained by voltage control on the generator and from 70 r.p.m. to 105 by field control of the motor. The master switch, which will be mounted in the pulpit, will be so arranged that there can be no distinction noticed in going from voltage control to field control. The above equipment was designed to take care of peak ratings of 7000 hp. momentarily.

The equipment for the 22-in. mill consists of a 2500-hp. induction motor provided with a shaft extension at each end. On one of the ends it is to receive a flexible coupling to connect the motor to the flywheel shaft, and the other end will be arranged to couple the synchronous machine to form an adjustable speed range of 358 to 614 r.p.m. and give constant horsepower at all speeds with this range. One end of the flywheel shaft will connect with a herringbone gear unit having a pinion speed of 500 r.p.m. and a gear speed of 110 r.p.m.

### Central Iron & Steel Co.

The Central Iron & Steel Co., Harrisburg, Pa., installed during 1923 new and improved grates for the burning of anthracite river coal in the main boiler house. Automatic stokers and pulverized coal burning equipment has been applied to the heating furnaces of the plate mill. There has been installed blanking presses, pickling vats, furnaces, etc., for the production of circular and variform blanks for the use of makers of pressed steel parts.

### Heppenstall Forge & Knife Co.

The Heppenstall Forge & Knife Co., Pittsburgh, added to its equipment last year, at its plant at Pittsburgh, three new shear knife grinders; an extension of crane facilities in the shear knife department, an enlargement and additional equipment in the heat treating division of the same department. In the power house a 1000 cu. ft. Ingersoll-Rand motor-driven air compressor was installed as additional air compressor capacity. In the machine shop two new roughing lathes, motor-driven, were installed.

### Columbia Steel Corporation

The Columbia Steel Corporation, San Francisco, Cal., is now erecting at a new plant at Ironton, near Provo, Utah, a 350-ton blast furnace and 33 Koppers by-product coke ovens. These are expected to be in operation about April 1. Foundry, malleable and basic pig iron will be made which will be shipped to its steel plants in California. The coke oven plant will have a daily carbonizing capacity of about 1000 tons of coal, mined in Utah.

At the company's steel mill at Pittsburg, Cal., there was constructed last year, two 75-ton basic open-hearth furnaces which were put in operation last fall. There was also installed a new rod mill which is now operating, and in addition to this there was built a complete wire and wire nail mill which is also now operating. At the same plant there is under construction a 4-stand sheet mill which will probably be put in operation early this year.

### Weirton Steel Co.

The Weirton Steel Co., Weirton, W. Va., last year completed and put in operation a new sheet mill consisting of eight hot and four cold mills, together with a galvanizing department. There was also put in operation last year a new by-product coke plant consisting of 37 Koppers ovens. A Dwight-Lloyd sintering plant for treating flue dust was installed last year, having an output of 150 tons of sinter per day.

### Other Steel Works Additions

Kilby Car & Foundry Co., Anniston, Ala., now has under construction a new forge shop in the shape of an all-steel building, 60 ft. by 70 ft., with a capacity of at least 1000 tons of forgings per month. The new shop is expected to be in operation by February or March.

The Ford Motor Co., Detroit, expects to have completed during the present year a new cement mill.

The American Rolling Mill Co., Middleton, Ohio, states that extensive additions have been made to its plants at Ashland, Ky., definite information concerning which cannot at present be given out.

The National Enameling & Stamping Co., Granite City, Ill., last year installed a new plate mill, a new jobbing mill and six sheet mills.

The Nagle Steel Co., Pottstown, Pa., in 1923 installed one oil-fired continuous heating furnace.

The Ludlum Steel Co., Watervliet, N. Y., last year added to its equipment a new 5-ton Ludlum electric melting furnace; a new boiler house containing two boilers of 600 hp. each; a new 4-door heating furnace in the hammer shop, and one wire annealing furnace.

Superior Steel Corporation, Pittsburgh, works at Carnegie, Pa., installed last year a new 20-in. cold-rolling mill and several new annealing furnaces.

Pittsburgh Steel Co., Pittsburgh, added to its equipment last year a class 68-D Baldwin locomotive and 25 steel gondola cars of 150,000 lb. capacity each.

Firth-Sterling Steel Co., McKeesport, Pa., installed last year a new 10-in. mill with a capacity of 15 tons per 24 hr. In 1924 a new 3-ton electric furnace is to be put in operation.

## NEW ROLLING MILL WORK

Installations of new rolling mill capacity, outside of those plants having steel-making departments, in 1923 and that planned for 1924, are as follows:

### Reading Iron Co.

The Reading Iron Co., Reading, Pa., announces that it has undertaken the building of an entirely new charcoal iron department in the building formerly used as a forge. The construction work began in the spring of 1923 and it is expected the new plant will be completed sometime in February or March this year. The plant will contain 20 knobbling fires with two hammers and a 23-in. bar mill for rolling the blooms into bars, the mill having two coal-fired heating furnaces with Cahall waste heat boilers. The skelp mill is an 18-in. 3-high tandem one, consisting of one roughing stand, one set of strand rolls and a set of bull heads. The mills will have automatic lifting tables and run-out tables as well as an automatic traveling cooling bed with a turn-over for the inspection of the skelp. There will be four coal-fired heating furnaces for the skelp mill, each equipped with Cahall waste heat boilers. It is the intention to use the skelp mill for the rolling of charcoal iron boiler tube skelp and in addition certain sizes of wrought iron pipe skelp will be rolled from puddle bars shipped into the mill from other departments. The mills will be engine driven, using the steam from the waste heat boilers, and the strand rolls will be driven from the same engine as the roughing rolls by means of a rope drive. The mill will have an outside crane runway for the handling of materials and there will be a large charcoal storage house equipped with conveyors for the cheap unloading and storing of charcoal.

### Bryden-Neverslip Co.

Bryden-Neverslip Co., New Brunswick, N. J., with works at Catasauqua, Pa., and Montreal, Canada, states that in 1923 it sold its New Brunswick property and moved the equipment to a new building at its plant at Catasauqua, Pa. The company recently started and will complete early this year a new steel mill building at Catasauqua in which there is being erected new regenerating heating furnaces, gas producers and electrically driven 20 in. and 10 in. rolling mills.

### Chapman Price Steel Co.

Chapman Price Steel Co., Indianapolis, Ind., increased its sheet mill capacity from five to six mills last year and added one galvanizing pot for galvanizing

sheets, thereby increasing the galvanizing capacity from three to four pots.

### Logan Iron & Steel Co.

Logan Iron & Steel Co., Philadelphia, demolished during 1923 several wooden additions at the west end of its main building and replaced them with a new and modern addition of steel construction about 100 ft. by 160 ft., this bringing all of its puddling and rolling operations in one steel building approximating 677 ft. in length.

### Other Rolling Mill Work

Arnolds Iron & Steel Mills, Fort Smith, Ark., last year converted its 10-in. bar mill into a Belgian 16 in. by 10 in. and is now making an addition to its plant for producing reinforcing bars from billets. Two additional furnaces have also been installed.

Franklin Steel Works, Franklin, Pa., added last year two sets of 12-in. mills and a set of pinions, which is not really a new mill but an auxiliary, adding but little to the company's capacity.

Eddystone Steel Co., Crum Lynne, Pa., plans to install in 1924 a new 44-in. mill for rolling blue annealed sheets. There is also under consideration the changing of a 22-in. 3-high bar mill into a strip mill but details are not yet completed nor decided upon.

The Texas Steel Co., successor to G. W. Armstrong & Co., Port Worth, Tex., last year installed one 3-ton Moore electric furnace.

The Fort Dodge Culvert & Steel Co., Fort Dodge, Iowa, expects to install this year an equipment to reroll rails into small shapes, most of which will be converted into fence posts.

The Metal & Thermit Corporation, with general offices at 120 Broadway, New York, started the erection last year at South San Francisco, Cal., a new 2-high sheet mill which it is expected will be finished early this year. The output is estimated at 28,000 tons per year of both black and galvanized sheets.

## BLAST FURNACE WORK

The McKinney Steel Co., Cleveland, commenced the rebuilding of its No. 1 River furnace during the latter part of last year. This will be enlarged to a 22 x 91-ft. stack, with a daily capacity of 600 tons. It is expected that the furnace will be ready for operation in July.

The Perry Iron Co., Erie, Pa., started the tearing down of its stack in December and will rebuild it during 1924. The diameter of the furnace will not be changed, but its height will be increased 10 ft. A ship hoist will be installed, changing the stack from a hand filled to a mechanically filled furnace, and changes will be made in the bin arrangement.

The Central Furnace Co., Massillon, Ohio, was organized during 1923 by interests affiliated with the Central Steel Co., Massillon, and the Cleveland-Cliffs Iron Co., Cleveland, with a view of building a blast furnace in connection with the Central Steel Co. Engineers are now working on the plans for this plant, but it has not yet been definitely decided whether the furnace will be built.

The Shenango Furnace Co., Pittsburgh, with furnaces at Sharpsville, Pa., completed last year a new pig casting machine and is now installing new motor driven centrifugal pumps at the river, having a capacity of 10,000,000 gal. Besides this, the company has further united its No. 1 and No. 3 furnace units by erecting large gas mains and steam lines so that these two units are now hooked up into one economical plant. The company has built a modern, up-to-date machine shop at Sharpsville, replacing one destroyed by fire in 1923. The building is steel and concrete and equipped with modern machinery as well as wood-working machinery for the carpentry shop and a steam hammer for the blacksmith's shop.

Witherbee, Sherman & Co., Port Henry, N. Y., besides starting up a new blast furnace last year, installed two Ingersoll-Rand turbines, with barometric condensers; a pumping plant having three Worthington centrifugal pumps of 5500 gal. per min. capacity, including a water standpipe 137 ft. by 20 ft. There was also put in five Sterling boilers of 120 to 250-lb. pressure, equipped with Burkholtz burners. A Brassert washer was put in together with a new strand pig machine. New buildings added included a power house, a boiler house, a stock house and warehouse. There was placed in operation last October a Greenawalt sintering plant of 250 tons capacity with provision for installation of two more plants. During 1924 two additional pans will be installed to the present sintering plant.

Norton Iron Works, Ashland, Ky., made some extensive repairs to its blast furnace last year, increasing its capacity about 100 tons.

Lavino Furnace Co., Philadelphia, added a new 90 × 20-ft. three-pass stove at its Sheridan, Pa., plant.

The Jackson Iron & Steel Co., Jackson, Ohio, relined its furnace last year, together with a general overhauling of the entire plant. Minor additions, such as a pig breaker, are now under construction.

Colonial Iron Co., Riddlesburg, Pa., has under erection a new coal breaker for preparing screened sizes of domestic coal. The stock will be used to make coke.

The Donner Steel Co., Inc., Buffalo, N. Y., put in operation early in November last year a Freyn & Brassert gas washer at one of its blast furnaces.

St. Louis Coke & Iron Co., Granite City, Ill., still intends to build an additional blast furnace in the very near future, although the plan as announced a year ago in this review has not yet been carried out.

Allen S. Davison Co., sales manager and operator of the Sharpsville Furnace Co., Sharpsville, Pa., states that last year it finished rebuilding its furnace and put it in operation, the unit now having a rated capacity of 400 tons per day. Besides new bins, there was installed an automatically filled top, additional blowing equipment, a new cast house and a pig machine. The annual capacity of the furnace is now rated at 140,000 tons.

The Hamilton Furnace Co., Hamilton, Ohio, has not yet completed the building of its No. 2 furnace which was under construction last year. It is hoped to finish this during the present year.

The Central Steel Co., Massillon, Ohio, has under projection the building of a 700-ton blast furnace which it is hoped to start building during 1924.

### Additions to Steel Foundries

The Ohio Steel Foundry Co., Lyman, Ohio, last year built a new 20-ton basic open-hearth furnace with checker chambers incased in a steel shell, entirely covered and insulated with cellite. Flues are also insulated as far as the valves. There were also installed during the year eight large Hermann rollover molding machines and three Alliance traveling cranes, besides one locomotive frame drying oven. Considerable additional capacity is contemplated providing business conditions warrant.

The Riverside Steel Casting Co., Newark, N. J., built and started to operate a 10-ton acid open-hearth furnace in February, last year.

The Eagan-Rogers Steel & Iron Co., Crum Lynne, Pa., anticipates being compelled to increase its capacity at least 50 per cent this year. All pattern and flash equipment was standardized last year so as to enable the production of jobbing castings on the same basis as duplicate requirements. The company states that its present capacity is 3200 tons of miscellaneous light weight steel castings per year and that its 1923 output was close to 90 per cent of this capacity.

The Lebanon Steel Foundry, Lebanon, Pa., built an addition to its foundry, 50 by 160 ft., increasing capacity for steel castings from 350 to 450 tons a month. The portion of the main building destroyed by fire last May has been entirely replaced.

The Nugent Steel Castings Co., formerly the Electric Steel Co., Chicago, has under construction a 2-story pattern storage building, fire proof.

The American Manganese Steel Co., Chicago Heights, Ill., has recently purchased the plant formerly oper-

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ESTABLISHED 1855

# THE IRON AGE

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## Tonnage Prospects for 1924

WHILE predictions are hazardous as to steel production in 1924, estimates based upon the outlook as now seen may not be out of place. Such guesses are naturally comparative, relating 1924 with 1923. A spirit of conservatism should obtain, for 1923 has been an exceptionally heavy tonnage year.

One cannot readily forget the predictions made during the war, that afterwards a large pent-up demand for steel would be released. When four years had passed after the war the rational conclusion would be either that there was no large demand to be released or that it could not be expected at any particular time. The production of steel ingots in the United States, as a matter of fact, averaged 32,000,000 tons a year during those four post-war years, 1919 to 1922, inclusive. This cannot well be called "normal" for two reasons: because we have no such thing as a general normal in steel and because those four years showed such wide variations—between the 40,881,000 tons of 1920 and the 19,224,000 tons of 1921—that they can represent nothing but an average. However, an average made by the four immediate post-war years is entitled to some respect.

Production of ingots in 11 months of 1923 amounted to 40,383,191 tons, pointing to a calendar year total slightly exceeding 43,000,000 tons, but failing to pass the historic record of 43,619,000 tons made in the war year 1917. At 43,000,000 tons, 1923 exceeds the average of the first four post-war years by 35 per cent, and makes the average for the five post-war years 34,200,000 tons.

The prevalent view today in the steel trade is that 1924 will be a relatively good tonnage year but not an exceptional one. The year just ended must be considered exceptional. The opinion then would be that 1924 will lie between the 34,000,000 tons shown by the five-year average and the 43,000,000 tons shown by the exceptional year.

As to individual lines of consumption there are some fairly clear points. Freight car buying lately has run at, say, 2500 cars a week, a rate sufficient to make much more buying than the average of the five years, and not far from the total for 1923. Rail buying for the first half of 1924 points to as large production as in the past year. In respect to other railroad buying, also, 1924 promises well unless the railroads are discouraged by a strongly adverse situation in Congress.

In steel required in dwelling house construction—nails, pipe, metal lath, etc.—the present outlook is for no more than a slight decrease from 1923. If buying by farmers depends on buying power there should be more activity in 1924.

In large construction projects, involving fabricated steel, a moderate volume of demand is in prospect, pointing to no great difference in production between 1923 and 1924.

For the past few months oil trade prospects of steel consumption have seemed poor, but the turn in the statistical position has occurred, and as 1923 was adversely affected, improvement may be sufficient to make demand for oil country tubular goods heavier, taking the calendar year as a whole.

Various other lines of steel consumption present mixed prospects. Tin plate mills are already assured of good operations in the first half.

Summing up, the present outlook seems to be for an ingot production in 1924 below the 43,000,000 tons of this year, but considerably above the 34,000,000 tons in the five-year average. The outlook will change more or less from month to month, for nothing is ever certain in steel.

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## New Heat Treatment of Cast Iron

MORE knowledge of the effect of heat treatment on cast iron is an important legacy of 1923. Some of the results are notable. The past few years have been full of effort in the application of heat-treating methods, new and old, to steel, and there have been many successes. Only recently has any like attention been given to cast iron.

The first results in 1922 were discouraging, the annealing of gray iron only weakening it. About the middle of last year the attention of metallurgists was arrested by word from Germany and elsewhere of "pearlitic cast iron"—really a product of one form of heat treatment. At the October convention of the steel treaters

the partial success of attempts to case-harden cast iron was made public.

The climax of such work on cast iron is found, however, in the detailed description and discussion elsewhere in this issue, of a new but simple heat treatment method. Apparently either gray or white iron is transformed, and in a very short time, into a metal possessing remarkable malleability. Machining properties are greatly improved and strength and pliability enhanced to a marked degree. The cast iron is converted into something superior to malleable iron or into a metal approaching steel. In short, a high degree of malleabilization is produced.

Whether the transformation, as demonstrated by the tests and photomicrographs, is due to the atmosphere of the furnace or, perhaps, to a still more powerful agency, it is too early to judge. What seems conclusive is that the new heat treatment has opened up a field full of interesting possibilities. Instead of 72 hours, malleabilizing may be possible commercially in one hour. Certainly the difficulties in machining cast iron may be removed or greatly mitigated.

Not long ago it was said that the field of the heat treatment of steel had been but scratched. Certainly that of cast iron has hardly been touched. It is possible that some part of the Schaap method may be applied to steel, considerably altering present practice. And gray cast iron may yet find entrance to fields from which, by its constitution, it has been considered effectually barred.

## An Interpretation of Henry Ford

HENRY FORD has been much talked of as a possible future President of the United States. Any man might be proud to be so considered by large numbers of his countrymen. Whether Mr. Ford had serious thought of incurring the confinement of the great office or the performance of its extremely arduous duties may never be known, but his declaration in favor of the retention of President Coolidge in the White House has removed all doubt as to where he stands. He will, however, continue to be a most interesting personality and perhaps a more influential factor than if he had become a candidate for the Presidency.

Henry Ford is a great manufacturer, perhaps the greatest that we have. He made an ingenious invention that was put on the market at a time when the popular psychology for it was just right. The inwardness of the commercial development, how much of it was due to Mr. Ford himself and how much to his associates, is not commonly known. Up to about four years ago the organization creaked and at one time in 1920 it seemed to be cracking, but since then there has been a leadership in it which has made it the apotheosis of industrial manufacturing.

This has resulted in making Mr. Ford about the richest man in America. There is no envy of his great wealth or any malice toward him. On the contrary, he is most popular among the humble. This is largely because he is recognized to have acquired his wealth in the fairest kind of way, without wittingly harming anybody, and by doing the public a service that could be visualized and appreciated. The accumulation of this great fortune and the disposition of it are, of course, of intense interest, economically and sociologically.

Henry Ford has essentially the mind of a mechanic, an intelligent mechanic to whom the books of knowledge are slowly being opened. Such a one might in early years have worked long upon an ingenious contrivance for perpetual motion, without knowledge of the law of conservation of energy, and then in his disappointment might have invented something as intricate, ingenious and useful as a sewing machine or a linotype machine. To such a one a banker is a pawnbroker, one to be resorted to only when hard up. Mr. Ford knows better than that, but he has let us see that his ideas of the principles of money are of the vaguest. He is disregardful of the elements of economic science simply because he never heard of them. Sometimes when a truth is revealed to him by his own research, he hails it naïvely as a new discovery. When he is instructed by a teacher he is frank in his astonishment.

We discern something of this in his industrial enterprises afield from the making of motor cars. It appears to be the present policy of the Ford Motor Co. to take in nothing but raw materials, even to produce the raw materials themselves, and turn out automobiles ready for the road. So a blast furnace plant is built, a railroad is acquired, a timber tract is bought and developed, and we hear that under the inspiration of Mr. Ford the management of those industries is much superior to that of experienced iron masters, railroaders and foresters, when, in fact, there may be only a näive discovery of old principles.

Amid much rubbish, such as peace ships, work-dollars, aversion to Jews, etc., in the mind of Mr. Ford there are diamonds to be found. The kohinoor of these is the idea that rather than in philanthropy his great fortune should be spent for the creation of industries and for giving to people the means of helping themselves. This is economically of the soundest. Indeed its very soundness, combined with the ingenuousness and stupendous financial resources of the man, may lead to astonishing results, so astonishing that this may be one of the most exciting industrial experiments of record.

Many projects that have been proposed have been condemned by engineers as being too hazardous. Some have been tested tentatively and then dismissed as being too uncertain. Ordinary capitalists cannot afford to take excessive chances in mere exploration. They have been wont, indeed, to enter upon great adventures, such as the porphyry copper deposits 15 years ago, or the more recent and even bolder development of Chuquicamata by the Guggenheims; but those were sanctioned and recommended by the best engineering advice of America. Not so with Henry Ford. To him the adverse chances of industrial wildcatting are immaterial. What matters it to him if a million be lost here and there?

The Ford Motor Co. uses a great deal of lead

for storage batteries and solder, so it concluded it would be a good thing to have a lead mine of its own and began drilling around Irondale in southeastern Missouri. Lead mining men have had dreams of ore deposits occurring there and have made some casual explorations, but they have had no stomach to see the thing through. Henry Ford may do so easily and may possibly develop a good mine. If he fails, he will come to no harm. Similarly he might tackle the alunite deposits of Utah and out of them succeed in making aluminum for his cars, with potash as a by-product for the farmers; or he might pump out and test the Temescal mine in California to see if it would not yield him a tin supply; or he might exploit the oil shales of Colorado. We are merely indicating possibilities that mining men have talked about without having the heart to try.

If such proves to be the program of Mr. Ford, there will be nothing disparaging in failures. Many of them may be expected. We urge upon him, however, to let a full record of failures be made and published. The Ford Motor Co. is big enough to do that, and with its concentrated ownership it does not have captious stockholders to consider. The records of failures in one generation are not infrequently the guides to success in the next. We pray that Mr. Ford, with his wonderful public spirit, will give attention to this thought.

## American Steel 60 Per Cent of All

NOT until the passing of the fifth year since the close of the great war was more steel produced by the leading nations of the world than in the year before the war. According to a review of the world's steel industry elsewhere in this issue, the five leading nations made in 1923 more steel than the total for the same countries 10 years before.

Last year the United States, Great Britain, France, Belgium and Germany made over 65,767,000 gross tons of steel ingots and castings, or about 2,392,000 tons more than that of 10 years ago. This has been possible by the regaining of lost ground last year by Belgium, France and Great Britain and by the striking record of the American industry. Had Germany been able to operate, the gain would have been larger. For the 17 producing countries we estimate the output of steel last year at about 71,000,000 tons. At 43,250,000 tons, the output of the United States was over 60 per cent of the total.

In pig iron the world's needs are still below those of 1913. Despite the phenomenal American production and the return to nearly normal in Belgium and France, the low operations of the British and German industries have kept the 1923 total nearly 5,600,000 tons less than that of 10 years ago. Undoubtedly a much larger use of scrap and the high cost of fuel were important factors.

But the most notable feature of last year's record is the continued low consumption of the non-producing countries of the world. In 1923 the five nations sold only 1,000,000 tons more than in 1922, leaving a deficit as compared with 1913 of more than 4,000,000 tons—12,244,600 tons, compared with 16,288,000 tons. Home consumption of the American output was never so great, but our exports were on the low scale of 1922, Germany alone of the five countries making a smaller showing.

The developments of the past year indicate that economic and industrial conditions are still chaotic in several countries. The French occupation of the Ruhr retarded adjustment in the steel industry of other countries besides Germany. A return to normal, as represented by pre-war conditions, is still somewhat distant, but the year's progress toward that goal was more rapid than for any other post-war year.

## The Public Out of Coal

FOR a short time it appeared that there were three parties interested in the production and marketing of coal—the miners, the operators and the public. But the public seems to have been dropped. Among producers, dealers and consumers there has been much discussion lately of what will occur in bituminous coal April 1. The discussion concerns itself only with what the operators, Mr. Lewis and the United Mine Workers may do. No one mentions the United States Government or the public. The Government finished with coal when it paid the Coal Commission and accepted its report last September. The public apparently will never get through.

There was a hope, though perhaps only a faint hope, that the work of the Coal Commission would be followed by Congressional action. The politicians are more interested in getting votes than in running chances of losing votes, and no one talks now of the possibility of Congress so acting as to prevent a strike or suspension April 1.

Edgar Allen Poe, indorsed in our own time by Sherlock Holmes, pointed out that it is the bizarre and unusual in crime that makes it easy to get at the facts. Our coal industry presents paradoxes, and to most people this appears to have made the problem insoluble. It ought to make it easy. It is the ordinary crime, just like other crimes, that is hard to fathom. An industry that is operating like other industries, yet has trouble, would be a hard one to set on the right track.

Repeatedly it has been said, and accepted as good sense, that the selling price of coal averages high because there are too many coal mines and too many miners. Consumers, therefore, have to pay high prices for coal on account of excessive overhead and the necessity of supporting miners in idleness for large fractions of the year. That is entirely contrary to the accepted rules of trade, as every one knows. The paradox ought to emphasize the peculiarity of coal and suggest the remedy.

We have the Sherman law, against restraint of trade, now just a third of a century old. For quite a while it was thought by many it could not be made to work, or if it were enforced business enterprise would be throttled and the country be put in a bad way. In recent years the Sherman law has been enforced and we find that business pro-

ceeds. The Sherman law is against agreements in restraint of trade. In the coal industry there is restraint of trade, large numbers of mines being closed for long periods, but there is no agreement. The restraint is produced by a disagreement. The Sherman law was passed with the idea of preventing restraint of trade, and its language was made broad and sweeping. Its framers used the word "agreement" as being comprehensive. Now we have the apparent paradox that a disagreement is more effective in restraining trade than any conceivable agreement could be.

Surely these paradoxes should help to point a way to solution. The voluminous report of "facts" found by the Coal Commission serves only to make it appear that the matter is intricate and involved. It is bizarre and unique that disagreements result in restraint of trade and that a commodity is high priced because there is so much competition. A unique evil requires a unique remedy.

# Pig Iron Production for December

## Estimated Output, Collected Largely by Telegraph, Shows Decline of Only 2251 Tons Per Day from November —Net Gain of One Furnace

THE pig iron production for December, compiled from returns collected entirely by telegraph, was 2,920,982 gross tons, the output for the last two or three days being estimated. Prompt publication is made possible by the excellent cooperation of the producers. The daily rate was 94,225 tons, or the lowest for the year, that of January having been 94,990 tons.

The production of coke and anthracite iron last month was somewhat larger than anticipated. The 2,920,982 tons made in the 31 days of December compares with 2,894,295 tons made in the 30 days of November. The December daily rate was 2251 tons less than the November rate, which was 96,476 tons per day.

There was a net gain of one furnace in December, seven having been blown in and six blown out, leaving 232 furnaces in blast on Jan. 1. There were 231 furnaces in blast Dec. 1. This is the first net gain in furnaces since July 1, the 323 furnaces then in blast being the largest number for the year. After that there was a gradual decline to 231 on Dec. 1.

Among the furnaces blown in during December were the following: One Harriet furnace in the Buffalo district and one furnace of the Northern Iron Co., in New York; one furnace of the Bethlehem Steel Co. at Bethlehem plant and one at the Johnstown plant in Pennsylvania; the Mattie furnace in the Mahoning Valley; one furnace of the Colorado Fuel & Iron Co. in Colorado and one city furnace of the Sloss-Sheffield Steel & Iron Co. in Alabama.

Among the furnaces blown out or banked during December were the following: One furnace of the Pittsburgh Steel Co. at Monessen, in the Pittsburgh district; the Earlston and Emporium furnaces, in western Pennsylvania; the Buena Vista furnace of the Allegheny Ore & Iron Co. in Virginia; one furnace of the National Tube Co. in northern Ohio, and the La Follette furnace in Tennessee.

### Output by Districts

The accompanying table gives the production of all coke and anthracite furnaces for December and the three months preceding:

*Pig Iron Production by Districts, Gross Tons*

| | Dec. (31 days) | Nov. (30 days) | Oct. (31 days) | Sept. (30 days) |
|---|---|---|---|---|
| New York | 204,157 | 193,621 | 219,857 | 208,737 |
| New Jersey | 19,272 | 18,509 | 19,473 | 18,293 |
| Lehigh Valley | 83,332 | 82,748 | 81,614 | 73,945 |
| Schuylkill Valley | 71,838 | 73,069 | 91,457 | 88,699 |
| Lower Susquehanna and Lebanon Valleys | 64,002 | 63,720 | 60,568 | 56,531 |
| Pittsburgh district | 595,317 | 595,876 | 653,970 | 659,963 |
| Shenango Valley | 97,527 | 99,228 | 117,656 | 127,781 |
| Western Pa. | 109,419 | 116,910 | 157,649 | 157,960 |
| Maryland, Virginia and Kentucky | 61,470 | 68,787 | 60,278 | 55,581 |
| Wheeling district | 140,659 | 136,349 | 141,598 | 147,771 |
| Mahoning Valley | 293,043 | 280,667 | 279,834 | 286,558 |
| Central and Northern Ohio | 266,128 | 265,198 | 282,009 | 273,885 |
| Southern Ohio | 44,708 | 24,619 | 36,083 | 37,416 |
| Illinois and Indiana | 522,994 | 535,362 | 595,457 | 587,323 |
| Mich., Minn., Mo., Wis. and Colo. | 124,993 | 111,291 | 117,128 | 113,460 |
| Alabama | 214,013 | 215,613 | 213,105 | 213,083 |
| Tennessee | 8,110 | 12,676 | 21,427 | 18,526 |
| Total | 2,920,982 | 2,894,295 | 3,149,158 | 3,125,512 |

Detailed pig iron statistics for December will be published in THE IRON AGE, Jan. 10, 1924.

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The Interstate Commerce Commission has suspended from Jan. 1 to April 30 tariff schedules proposing to increase the rates on iron and steel products in carloads between points in Illinois, Indiana and Missouri. Typical of the proposed increases are those relating to steel rods, bars, and boiler plate the rates on which would have been advanced from 13c. to 17.5c. per 100 lb. from Fort Wayne, Ind., to Paris, Ill., and from 15.5c. to 17.5c. per 100 lb from Chicago to Brazil, Ind.

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### Judge Gary Confident the Twelve-Hour Day in Steel Plants Will Not Return

Judge Elbert H. Gary, chairman of the United States Steel Corporation, returned to his office, 71 Broadway, New York, Monday, after an absence of a week in Chicago. He said that he had nothing to add to his recent statements in regard to business conditions and the outlook for the new year, but he believed that a distinct change for the better took place about two months ago.

In reply to a question as to the abolishing of the 12-hr. day, Judge Gary said that the change had been completed so far as the Steel Corporation is concerned. As to the independents, some had not yet made the change, but he did not wish to criticize anyone on account of the delay, for all probably had what they believed good reasons for not quickly abolishing the long day.

Asked his opinion as to the permanency of the shorter hours when pressure for production becomes greater, Judge Gary said in a confident manner: "I believe that we can maintain the new system," and with a smile he turned to an electric sign near his desk which, when he pushes an electric button, reads, "IT CAN BE DONE." His manner indicated determination to adhere to the short day without deviation.

# Iron and Steel Markets

## BETTER OUTLOOK FOR 1924

### First Quarter Operation of Mills Fairly Assured

### Small Decrease in Pig Iron Output—Railroad Steel Far in the Lead Last Year

The activity in finished steel that has been commented on in the past two weeks is more pronounced as 1924 opens. Reports from the principal market centers agree that good mill operations are assured for the first quarter in practically all products apart from plates and bars, and in respect to these prospects have improved.

Significance attaches to this week's scale of operations of the Steel Corporation, which is close to 80 per cent, even though this involves some stocking of ingots and semi-finished steel at plants rolling the heavier products.

Automobile makers have made further contracts for bars and body sheets and there has been rather well distributed buying of bars in other lines. The Ford Motor Co. is understood to have placed at Buffalo and Cleveland a good part of the 70,000 tons of bars for which it inquired three weeks ago, and that it secured some concession from the 2.40c. price to which the larger companies have held.

One year ago the strong buying movement was on an advancing market and part of the demand was plainly for accumulation of stocks. Today, when no price advances are in prospect, the buying is seen to be for early use.

The difference in the conditions then and now appears in unfilled orders for 6,745,000 tons on the Steel Corporation's books one year ago and an estimate of about 4,100,000 tons as of Dec. 31, 1923. December had larger bookings than November, and December operations slowed down less than was expected.

There is promise of increased railroad buying early in the new year, but the past week has added several contracts at Chicago. One is for 25,000 tons of rails and 6300 tons of track supplies. The Southern Pacific car order is for 5480 and in addition it will build 1075 in its own shops. The Pacific Fruit Express contract for 3057 refrigerator cars is looked for this week.

The need of equipment business appears from the fact that on Nov. 30 undelivered freight cars on the books of the car builders numbered 28,092, as against 108,487 one year ago.

Including the New York Telephone Co. building, 18,000 tons, structural awards of the week amounted to 36,000 tons, while new work was in smaller volume than in recent weeks, being about 15,000 tons.

Pig-iron production held up well in December, and for the first time in seven months there was a gain in the number of active furnaces, 232 being in blast Jan. 1 against 231 on Dec. 1. The December output was 2,920,928 tons, or 94,225 tons a day, against 2,894,295 tons in the 30 days of November, or 96,476 tons a day. In the last few days of the year a number of furnaces were slowed down.

Transactions in pig iron have been almost entirely speculative buying. Middlemen are credited with purchases of 50,000 tons, half of which was basic, at Youngstown and Portsmouth, and the remainder Bessemer, foundry and malleable grades. New York banking interests, however, do not take kindly to buying for speculation. While some resale iron is still available at slight concessions, prices named by furnaces are fairly firm but untested, owing to the limited buying.

An interesting item in the export trade is the placing of 12,000 tons of railroad car steel with American mills last week for shipment to Australia. The Chilean State Railways have divided their order for 15,000 tons of rails between American and Belgian mills.

Returns to THE IRON AGE from companies representing 84 per cent of the country's steel capacity indicate that the production of finished rolled steel in the United States in 1923 was about 31,600,000 tons, the output of steel ingots being about 43,250,000 tons. Railroads took 27 per cent of the steel produced last year, or a 50 per cent greater tonnage than in 1922. General construction work took 15.5 per cent of last year's output and the automotive industry 11 per cent.

In 1923 independent steel companies in the United States completed 19 new open-hearth steel furnaces, having an annual capacity of 875,000 tons. None were added by the Steel Corporation. At the beginning of 1924 seven open-hearth furnaces are under construction with capacity of 350,000 tons a year. Two of these are Steel Corporation furnaces.

For the first time in many years no new blast furnaces were added in 1923. On Jan. 1, 1924, five blast furnaces were under construction, with a capacity of 900,000 tons of pig iron a year.

## Pittsburgh

### High Hopes of a Prosperous Year Fortified by Recent Developments

PITTSBURGH, Dec. 31.—The year goes out, if not in a blaze of glory, certainly with rays of great promise. The change of attitude on the part of buyers, which began to manifest itself after the middle of the month, has become more pronounced in the last few days of the year. Sheet, strip, tin plate and wire mills have all accumulated good-sized back logs of first quarter business and hopes are now strong that before the new year is very far along there will be fuller engagement of the plate, shape and bar mills, as well as of the pipe mills. Railroad buying is expected to come out with some freedom in January or the early part of February, and the change in the oil situation already has been reflected in a material increase in the inquiry for oil well tubular goods.

Price stabilization seems to have been accomplished. Hope is no longer strong among buyers that plates, shapes and bars will be lower in the near future and concessions from what have been recognized as the regular market price on other finished products have largely disappeared. A few sheet makers still are taking black and galvanized sheets at concessions on tonnages for prompt delivery, but on forward commit-

# A Comparison of Prices

**Advances Over the Previous Week in Heavy Type, Declines in Italics**

**At date, one week, one month, and one year previous**

## For Early Delivery

| **Pig Iron,** Per Gross Ton: | Dec. 31, 1923 | Dec. 24, 1923 | Dec. 4, 1923 | Jan. 2, 1923 |
|---|---|---|---|---|
| No. 2X, Philadelphia‡ | $24.26 | $24.26 | $24.26 | $29.76 |
| No. 2, Valley furnace† | 22.00 | 22.00 | 22.00 | 27.00 |
| No. 2, Southern, Cin'ti† | 25.05 | 25.05 | 25.05 | 27.05 |
| No. 2, Birmingham, Ala.† | 21.00 | 21.00 | 21.00 | 23.00 |
| No. 2 foundry, Chicago* | 23.00 | 23.00 | 23.00 | 28.00 |
| Basic, del'd, eastern Pa | 23.25 | 23.25 | 22.75 | 26.75 |
| Basic, Valley furnace | 21.00 | 21.00 | 21.00 | 25.00 |
| Valley Bessemer, del. P'gh. | 24.76 | 24.76 | 24.26 | 29.27 |
| Malleable, Chicago* | 23.00 | 23.00 | 23.00 | 28.00 |
| Malleable, Valley | **22.00** | 20.00 | 20.00 | 27.00 |
| Gray forge, Pittsburgh | 23.26 | 23.26 | 23.26 | 28.27 |
| L. S. charcoal, Chicago | 29.15 | 29.15 | 29.15 | 33.15 |
| Ferromanganese, furnace | 109.00 | 109.00 | 107.50 | 100.00 |

| **Rails, Billets, Etc.,** Per Gross Ton: | Cents | Cents | Cents | Cents |
|---|---|---|---|---|
| O.-h. rails, heavy, at mill | $43.00 | $43.00 | $43.00 | $43.00 |
| Bess. billets, Pittsburgh | 40.00 | 40.00 | 40.00 | 36.50 |
| O.-h. billets, Pittsburgh | 40.00 | 40.00 | 40.00 | 36.50 |
| O.-h. sheet bars, P'gh | 42.50 | 42.50 | 42.50 | 36.50 |
| Forging billets, base, P'gh. | 45.00 | 45.00 | 45.00 | 43.00 |
| O.-h. billets, Phila | 45.17 | 45.17 | 45.17 | 42.17 |
| Wire rods, Pittsburgh | 51.00 | 51.00 | 51.00 | 45.00 |
| Skelp, gr. steel, P'gh, lb. | 2.35 | 2.35 | 2.35 | 2.00 |
| Light rails at mill | 2.25 | 2.25 | 2.25 | 2.10 |

| **Finished Iron and Steel,** *Per Lb. to Large Buyers:* | Cents | Cents | Cents | Cents |
|---|---|---|---|---|
| Iron bars, Philadelphia | 2.62 | 2.62 | 2.67 | 2.325 |
| Iron bars, Chicago | 2.40 | 2.40 | 2.40 | 2.35 |
| Steel bars, Pittsburgh | 2.40 | 2.40 | 2.40 | 2.00 |
| Steel bars, Chicago | 2.50 | 2.50 | 2.50 | 2.10 |
| Steel bars, New York | 2.74 | 2.74 | 2.74 | 2.34 |
| Tank plates, Pittsburgh | 2.50 | 2.50 | 2.50 | 2.00 |
| Tank plates, Chicago | 2.60 | 2.60 | 2.60 | 2.30 |
| Tank plates, New York | 2.74 | 2.74 | 2.74 | 2.34 |
| Beams, Pittsburgh | 2.50 | 2.50 | 2.50 | 2.00 |
| Beams, Chicago | 2.60 | 2.60 | 2.60 | 2.20 |
| Beams, New York | 2.74 | 2.74 | 2.74 | 2.34 |
| Steel hoops, Pittsburgh | 3.00 | 3.00 | 3.00 | 2.75 |

*The average switching charge for delivery to foundries in the Chicago district is 61c. per ton.
†Silicon, 1.75 to 2.25. ‡Silicon, 2.25 to 2.75.

| **Sheets, Nails and Wire,** *Per Lb. to Large Buyers:* | Dec. 31, 1923 Cents | Dec. 24, 1923 Cents | Dec. 4, 1923 Cents | Jan. 2, 1923 Cents |
|---|---|---|---|---|
| Sheets, black, No. 28, P'gh. | 3.75 | 3.75 | 3.75 | 3.35 |
| Sheets, galv., No. 28, P'gh. | 4.90 | 4.90 | 4.85 | 4.35 |
| Sheets, blue an'l'd, 9 & 10 | 3.00 | 3.00 | 3.00 | 2.50 |
| Wire nails, Pittsburgh | 3.00 | 3.00 | 3.00 | 2.70 |
| Plain wire, Pittsburgh | 2.75 | 2.75 | 2.75 | 2.45 |
| Barbed wire, galv., P'gh. | 3.80 | 3.80 | 3.80 | 3.35 |
| Tin plate, 100-lb. box, P'gh. | $5.50 | $5.50 | $5.50 | $4.75 |

| **Old Material,** Per Gross Ton: | | | | |
|---|---|---|---|---|
| Carwheels, Chicago | *$20.00* | $20.50 | $19.00 | $25.50 |
| Carwheels, Philadelphia | 19.50 | 19.50 | 19.50 | 20.00 |
| Heavy steel scrap, P'gh | **19.50** | 19.00 | 18.50 | 21.00 |
| Heavy steel scrap, Phila. | 17.50 | 17.50 | 16.00 | 18.00 |
| Heavy steel scrap, Ch'go | *16.75* | 17.25 | 15.00 | 18.50 |
| No. 1 cast, Pittsburgh | *21.00* | 21.50 | 19.50 | 22.50 |
| No. 1 cast, Philadelphia | *20.50* | 21.00 | 20.00 | 22.00 |
| No. 1 cast, Ch'go (net ton) | 20.00 | 20.00 | 19.50 | 21.00 |
| No. 1 RR. wrot. Phila | 19.00 | 19.00 | 18.00 | 20.00 |
| No. 1 RR. wrot. Ch'go(net) | *15.50* | 16.00 | 13.50 | 16.75 |

| **Coke, Connellsville,** Per Net Ton at Oven: | | | | |
|---|---|---|---|---|
| Furnace coke, prompt | *$3.75* | $4.00 | $4.00 | $8.50 |
| Foundry coke, prompt | 4.75 | 4.75 | 5.00 | 9.00 |

| **Metals,** *Per Lb. to Large Buyers:* | Cents | Cents | Cents | Cents |
|---|---|---|---|---|
| Lake copper, New York | 13.25 | 13.25 | 13.25 | 14.75 |
| Electrolytic copper, refinery | *12.75* | 12.87½ | 12.87½ | 14.50 |
| Zinc, St. Louis | **6.27½** | 6.25 | 6.35 | 7.05 |
| Zinc, New York | **6.62½** | 6.60 | 6.70 | 7.40 |
| Lead, St. Louis | 7.75 | 7.75 | 7.00 | 7.10 |
| Lead, New York | 8.00 | 8.00 | 7.10 | 7.25 |
| Tin (Straits), New York | *46.75* | 47.30 | 47.25 | 39.00 |
| Antimony (Asiatic), N. Y. | *9.75* | 10.25 | 8.75 | 6.25 |

The prices in the above table are for domestic delivery and do not necessarily apply to export business.

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**Composite Price, Dec. 31, 1923, Finished Steel, 2.775c. Per Lb.**

| Based on prices of steel bars, beams, tank plates, plain wire, open-hearth rails, black pipe and black sheets. These products constitute 88 per cent of the United States output of finished steel | |
|---|---|
| Dec. 24, 1923, | 2.775c. |
| Dec. 4, 1923, | 2.775c. |
| Jan. 2, 1923, | 2.446c. |
| 10-year pre-war average, | 1.689c. |

**Composite Price, Dec. 31, 1923, Pig Iron, $21.88 Per Gross Ton**

| Based on average of basic and foundry irons, the basic being Valley quotation, the foundry an average of Chicago, Philadelphia and Birmingham | |
|---|---|
| Dec. 24, 1923, | $21.88 |
| Dec. 4, 1923, | 21.88 |
| Jan. 2, 1923, | 25.96 |
| 10-year pre-war average, | 15.72 |

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ments the market is no longer quotable below 3.85c. and 5c., base, respectively. It is a matter of comment that the market has shown so much activity in the face of the fact that higher prices are not in immediate prospect. Usually a buying movement is predicated upon the expectation of higher prices and since the Steel Corporation and the leading independents seem to have set their faces against any price change, the activity is regarded as evidence of the healthy and legitimate character of the buying.

**The pig iron market has reflected the improved steel market outlook to the extent that there is less tendency to shade what are regarded as the regular quotations. Trading in pig iron has been brisk in a speculative way, a middle interest being credited with purchases of about 50,000 tons of the various grades.**

**Further advances have been registered in scrap prices, but after a rise of $4 a ton in heavy melting grade, the market acts rather tired and there is a feeling that unless there are further Steel Corporation purchases, present prices will hold for a while, especially as the spread between scrap and pig iron costs to the furnaces now is very slim. There has not been sufficient demand to absorb the production of beehive oven coke and prices have eased off. The coal market also remains in buyers' favor.**

Pig Iron.—Consumptive buying in the past week has been on a very restricted scale; indeed, the market would have been very dull if it were not for a rather lively speculative demand. A middle interest is reported to have purchased in the past week or ten days about 50,000 tons, about half of the total being basic iron, purchased in Youngstown and Portsmouth, the remainder being 10,000 tons each of Bessemer and foun-

dry grades, and 5000 tons of malleable iron. The basic purchased in the Valley was at $21, furnace; the Bessemer $23, Valley furnace; foundry at $22 for the base grade and the malleable at $22, f.o.b., a western Pennsylvania furnace. Several other speculative inquiries are before the market. One merchant interest has an inquiry for 10,000 tons of foundry, carrying bids of $22.50 for the base grade and $23 for the No. 2X iron, and the inquiry reported a week ago for 10,000 tons of iron from New York banking interests has not yet been closed. New York interests are inclined to avoid such business, because there already is so much iron in brokerage hands. The demand, however, is encouraging as indicating that prices are regarded as low. The market derives strength also from the fact that steel companies which recently were disposed to sell their surplus production now, because of the improvement in the steel market, are inclined to look upon yard stocks more favorably. There appears to be no more malleable iron at less than $22, and with a good sized sale made during the week at that price, we revise our quotations accordingly. Quotations on other grades are unchanged, but they are less liable to shading than was recently the case. Pittsburgh Crucible Steel Co., having felt the betterment in the steel demand, is considering the putting into production of its No. 2 stack, which has been banked for several weeks. Average prices of basic and Bessemer iron from Valley furnaces in December, as compiled by W. P. Snyder & Co., disclose $20.857 and $22.775 respectively, as against $20.81 and $23.032 in November.

We quote Valley furnace, the freight rate for delivery to the Cleveland or Pittsburgh district being $1.76 per gross ton:

| | |
|---|---|
| Basic | $21.00 |
| Bessemer | 23.00 |
| Gray forge | $21.50 to 22.00 |
| No. 2 foundry | 22.00 to 22.50 |
| No. 3 foundry | 21.50 to 22.00 |
| Malleable | 22.00 to 22.50 |
| Low phosphorus, copper free | 29.00 to 30.00 |

**Ferroalloys.**—Consumers still are sparing in their purchases. Improvement in steel business is felt more strongly in finishing mill operations than in steel works, much steel piled during the last half of the year now being reheated and rolled. This condition tends to keep down consumption of the ferroalloys and to prolong existing supplies. Few steel companies have bought ferromanganese as freely as usual and the lining up of 1924 business in 50 per cent ferrosilicon has been attended with much more difficulty than in recent years, despite the decline in prices. Requirements are being figured very closely and purchases are in keeping with the fact that requirements for the first month or so of the new year do not promise to be heavy. The same degree of caution is observed in the demand for spiegeleisen. A fair amount of 1924 ferrochromium business has been closed at 10c. per lb. containing chromium for higher carbon material. Prices show no particular change. While some British producers of ferromanganese are meeting the domestic price on cash sales, most of them are unyielding at $110, c.i.f. Atlantic seaboard, duty paid. Ferrosilicon is fairly well established at $75, delivered, for 50 per cent material. Prices are given on page 135.

**Semi-Finished Steel.**—Open market activities are restricted by the fact that most consumers either have sufficient stocks or are protected against their probable first quarter requirements. Contracting has been fairly heavy in sheet bars, and two nearby strip makers have closed for their first quarter billet and slab tonnages; business of this sort has been at $42.50 for sheet bars and $40 for billets and slabs. There is an inquiry for 5000 tons of 1¾-in. billets from a Valley maker of hoops, bands and strips. Some mills are disposed to seek the same price for this size of billet as for sheet bars, but on the business recently closed no differential for size was exacted. Forging billets remain a little uncertain in price; the common quotation is $45, base, but on an order of attractive proportions, it is believed this price would be shaded. Makers of rods report the receipt of a fair number of contracts for the first quarter, but specifications are moderate and current orders are light. There is close observance of $51, base (No. 5 to ⅝-in.), for rods. Pipe skelp still is priced at 2.35c. to 2.40c., but as low as 2.30c. has been done and probably could be done again on the right sort of an order. Prices are given on page 135.

**Iron and Steel Bars.**—Buyers do not seem to have entirely abandoned the expectation of lower prices, but with many of them the need of supplies is more important than the price and there is a very fair volume of bookings at the full price. It is believed that the mills have pretty well completed their low-priced orders, but it is doubtful whether the low-priced steel in second hands is so well used up as to force purchases at today's base, which averages about $5 per ton above the invoice level. All mills are adhering rigidly to 2.40c., base, and repeated efforts by buyers to break that price have been unavailing. Iron bars also are firmly held at recent prices; inquiry is reported as better, but actual sales still are small, due in a measure to the fact that local car builders are not busy.

We quote soft steel bars, rolled from billets, at 2.40c. base; bars for cold-finishing of screw stock analysis, $3 per ton over base; reinforcing bars, rolled from billets, 2.40c. base; refined iron bars, 3.25c. base, in carload lots or more, f.o.b. Pittsburgh.

**Structural Material.**—Real activity still is lacking, but mills are encouraged to expect heavier purchases in the near future by the fact that structural lettings are reasonably heavy for the time of year and fabricating shops are figuring on the heavy amount of projected construction common to this season. There is no disposition by mills here to go below 2.50c. for large structural shapes, even on large tonnages. Prices are given on page 134.

**Plates.**—Orders are more numerous than they have been, but they usually run to small individual tonnages. The Southern Pacific Co. last Friday placed 6550 cars, mostly box type, with a number of builders, the Standard Steel Car Co., the Ralston Steel Car Co., the General American Tank Car Co. and the Pullman Co., sharing the business, which it is estimated will require about 70,000 tons of steel, mostly plates. Outside of the Ralston company requirements, most of the steel will go to Western mills. Mills here still are adhering firmly to 2.50c., base, on plates. Prices are given on page 134.

**Wire Products.**—Makers in this district are better provided with orders now than before in several months as a result of recent change of attitude on the part of buyers. Orders and specifications already are on hand to insure about 75 per cent operations of the mills throughout January and into February, while including the contracts against which specifications are yet to come, there is enough business in sight to maintain that rate of operation throughout the first quarter. Nails and manufacturers' wire lead in point of activity, but improvement is noted in woven fence orders. There is close observance of published prices; reports of price cuts locally are based upon reported offerings of nails by a local jobber at $3.02½ base per keg and of fence at 65½ per cent off list, against the mill discount to retailers of 65 per cent. Prices are given on page 134.

**Steel Rails.**—Mills rolling standard rails are well booked against production over the first half of 1924 and the railroads are reported to be specifying fairly freely, open weather so far this winter having permitted much more rail laying than usual. Light sections still are slow locally, chiefly because of the depression in the soft coal industry. The best demand for these sections is in the hard coal regions and the freight difference in favor of Eastern mills keeps down sales of local makers. Billet rails still are held at 2.25c., base, but rerolled rails are available from $5 to $10 a ton less.

We quote light rails rolled from billets at 2.25c. base (25-lb. to 45-lb.); rerolled rails, 1.85c. to 2c. base (12-lb. to 45-lb.), f.o.b. mill; standard rails, $43 per gross ton mill, for Bessemer and open-hearth sections.

**Tubular Goods.**—The situation has been featured by a decided quickening in the inquiry for oil country pipe. Change in the oil situation already has resulted in a revision of 1924 drilling programs with a consequent expansion in the probable pipe requirements. Inquiries to one mill foot up about 20,000 tons of oil well pipe

and there also has been some revival of interest in line pipe. Meanwhile, despite the requests for deferred shipment incident to the inventory period, most mills are shipping practically as much standard pipe as they are producing. The opening of the new year does not find the mills as heavily obligated as they were a year ago, chiefly because of the let-down in new oil land development over the last eight months of 1923. Boiler tubes still are slow and easy to secure, but the mills are well supplied with mechanical tube business. Discounts are given on page 134.

**Cold-Finished Steel Bars and Shafting.**—As there are no signs of higher prices and all makers are making such prompt deliveries, buyers still incline to a policy of placing orders rather than long time contracts. Most makers are better provided with orders than before in some time, chiefly because of demands from the automotive industry, but there is still room for improvement. Local price still is 3c., base, Pittsburgh, but on business originating in competitive territory, local mills are equalizing the freight with the Chicago mill quoting on a Chicago base. Ground shafting holds at 3.40c., base, f.o.b. mill for carloads or more.

**Hot-Rolled Flats.**—While new business has decreased considerably following the recent activity, most mills start the new year with a comfortable backlog of orders and there is marked firmness in prices. Several mills will be able to run almost full through January on orders and released tonnages and the industry as a whole is probably more than 60 per cent committed against production over the first quarter. All makers are quoting 3c., base, Pittsburgh, on hoops, bands and strips and that price appears to be well observed, though the fact that most consumers are well covered and out of the market in a large measure deprives the situation of a test. Prices are given on page 134.

**Cold-Rolled Strips.**—If there are any quotations below 5c., base, Pittsburgh, they are pretty well concealed. Mills generally booked a goodly amount of first quarter business and prices below that level have been withdrawn. The low point appears to have been 4.75c., base, although a large maker of low-priced motor cars is said to have covered his first quarter requirements at 4.65c.

**Bolts, Nuts and Rivets.**—There has been a slight easing in the price of cold-pressed nuts, the new quotation on which is 4.25c. off list for both blank and tapped, as against 4c., the former discount. Prices of other products under this heading show no change. On heavy rivets, slight concessions are being made on large orders; that, however, is ordinary practice. Business generally is better than it was a short time ago, makers having secured some good first quarter contracts, against which there are fair specifications. Prices and discounts are given on page 134.

**Track Supplies.**—One independent maker here has announced a base of \$3.05 per 100 lb. for large spikes and \$3.40 for small railroad and boat and barge spikes. The other independent maker here holds to \$3.15 and \$3.50. The quotable market on spikes is from \$3.05 to \$3.15 for large and \$3.25 to \$3.50 on the small railroad and boat and barge spikes, the latest quotation of the American Steel & Wire Co. on the latter kinds being \$3.25. Makers here are well supplied with large spike orders, a result of recent railroad awards, and anxiety for business is less marked. Bookings of small spikes are light because of the depressed soft coal situation. Tie plate orders are good, but much of the business was taken at less than quotations. Prices are given on page 134.

**Sheets.**—Business has been coming to the mills in heavy volume in the past week and a number of independent mills, notably those making full finished automobile body sheets, now are fully obligated for the first quarter. Prices below the regular market quotations continue to disappear and while a few mills are taking early shipment business at concessions, the full quotations now are general on forward delivery business. It is now believed that December sales of those manufacturers embraced by the National Association of Sheet and Tin Plate Manufacturers will set a new high record. To do so sales will have to exceed 400,000 tons as in December, 1922, sales were more than 399,000. Prices are given on page 134.

**Tin Plate.**—This product so far as new business is concerned, is a closed book for the first six months of 1924. All mills are fully sold for that period and it is probable that there is more business on makers' books than they can complete during that period, allowing for the usual interruptions to operations, when warm weather comes. The price is \$5.50 per base box, Pittsburgh, for standard cokes, with all makers.

**Coke and Coal.**—The beehive oven coke market is weak. There seems to be more spot furnace coke than is wanted and while \$4 per net ton at ovens still is asked and sometimes obtained, close buyers do not have to go above \$3.85 and have bought at as low as \$3.75. Warm weather has hurt the market for heating coke and with only a limited outlet for that grade, producers have been turning out more furnace fuel. The contract furnace coke market also is softer and now is quotable at \$4 to \$4.25. Spot foundry coke of good quality is readily obtainable at \$5 per net ton at ovens and regular 72-hr. coke can be bought at \$4.25. On first half contracts producers are quoting from \$5.50 to \$6.50. but the latter price is extreme as well as maximum, \$6 being the more common top price. Coal is dull at recent prices.

The Connellsville *Courier* places the production of coke in the Connellsville district for the year to Dec. 22 at 12,938,800 net tons against 7,474,380 tons in the same period in 1922.

**Old Material.**—While the Carnegie Steel Co. has failed to figure in the transactions of the week, for the first time in four weeks, there has been enough buying by independent companies to bring about a further advance in heavy melting steel scrap at 50c. a ton. At least two independent steel companies in the district have paid \$20 for that grade and there seems to be none available at less. One company is bidding \$19 and might go to \$19.25, but with dealers paying as much as \$19.50 to cover against sales, there is no place in the quotations for the lower figures. Efforts to interest others beside those who bought in this grade at \$20 have not been very successful in the past few days and the market gives signs of having reached the top for the present, since at \$20 the charging cost of scrap is practically at parity with that of molten pig iron of several companies. The rise in this grade tends to strengthen other steel works grades. The most recent sale of compressed sheets was at \$17.50 delivered, but the Westinghouse material of that kind for January shipment was sold at \$17.50, East Pittsburgh, which would mean \$18.25 at the nearest point of consumption without profit to the dealer. This grade cannot be bought today at less than \$17.50 and some holders would not sell at less than \$18. Higher prices are being paid for heavy breakable cast by steel companies, but the absence of foundry demand tends to hold the market in check on the grades used by the foundries. Blast furnace material is scarce and firm. The Pennsylvania Railroad will receive bids on Jan. 3 on 27,541 net tons of old material on its several divisions.

We quote for delivery to consumers' mill in the Pittsburgh and other districts taking the Pittsburgh freight rate as follows:

*Per Gross Ton*

| | |
|---|---|
| Heavy melting steel | \$19.50 to \$20.00 |
| No. 1 cast, cupola size | 21.00 to 21.50 |
| Rails for rolling, Newark and Cambridge, Ohio; Cumberland Md.; Huntington, W. Va., and Franklin, Pa. | 19.50 to 20.00 |
| Compressed sheet steel | 17.50 to 18.00 |
| Bundled sheets, sides and ends | 16.00 to 16.50 |
| Railroad knuckles and couplers | 20.00 to 21.00 |
| Railroad coil and leaf springs | 20.00 to 21.00 |
| Low phosphorus blooms and billet ends | 23.00 to 24.00 |
| Low phosphorus plate and other material | 22.00 to 23.00 |
| Railroad malleable | 18.50 to 19.00 |
| Steel car axles | 20.00 to 20.50 |
| Cast iron wheels | 18.50 to 19.00 |
| Rolled steel wheels | 20.00 to 21.00 |
| Machine shop turnings | 14.50 to 15.00 |
| Sheet bar crops | 20.00 to 20.50 |
| Heavy steel axle turnings | 16.50 to 17.00 |
| Short shoveling turnings | 15.50 to 16.00 |
| Heavy breakable cast | 18.50 to 19.00 |
| Stove plate | 14.50 to 15.00 |
| Cast iron borings | 15.50 to 16.00 |
| No. 1 railroad wrought | 14.50 to 15.00 |
| No. 2 railroad wrought | 19.50 to 20.00 |

# Chicago

## Encouraging Conditions at Close of Old Year —Southern Pacific Buys Cars

CHICAGO, Dec. 31.—The finished steel market will enter the new year under favorable auspices. Automotive interests, miscellaneous manufacturing consumers, and jobbers are no longer holding back their orders but are buying rather liberally for first quarter. The railroads continue to place rails and bridge work, while one line, the Southern Pacific, has bought 5480 freight cars and will build 1075 cars in its own shops, making a total of 6555. Action on the inquiry for 3057 refrigerator cars for the Pacific Fruit Express will be taken during the current week. While local steel works operations are unchanged—remaining at 75 per cent of ingot capacity—the mills' position is greatly improved. A leading local producer booked nearly twice as much new business in December as in November. This was an unexpected development in view of the fact that the last month in the year is usually a very quiet period. More significant still is the fact that this mill's bookings in December exceeded shipments, this being the first time new commitments have been heavier than deliveries for a considerable period.

Much of the recent buying has been for first quarter and the extent of these new obligations is indicated by the fact that a leading independent has already sold from 65 to 75 per cent of its estimated output during the next three months. Renewed activity in the building field, further increases in automobile production, railroad purchases of rolling stock, and generally sound conditions in most departments of industry are regarded as auguries for a busy first quarter in the steel mills.

**Pig Iron.**—Outside of small purchases for spot delivery, there has been little activity between the holidays. A few new inquiries, however, have appeared, one for local delivery during first quarter calling for 1000 tons and another for shipment during the same period to a northern Illinois melter, amounting to 400 tons. A leading Northern seller has advanced prices 50c. a ton to $23.50, Chicago furnace, effective Jan. 1, but the new quotation remains untested. The market outlook is regarded as favorable, particularly in view of the revival in steel buying and the evidences on every hand of continued industrial activity. Southern iron is firm at $21 base, Birmingham, and a sale of 500 tons for Indiana delivery was negotiated at $22. Charcoal is steady at $26 base furnace, a sale of 250 tons for Eastern delivery having been made at that price. Two carloads of low phosphorus were recently sold here at $34, delivered Chicago.

Quotations on Northern foundry high phosphorus malleable and basic irons are f.o.b. local furnace and do not include an average switching charge of 61c. per ton. Other prices are for iron delivered at consumer's yard or when so indicated, f.o.b. furnace other than local.

| | | |
|---|---|---|
| Lake Superior charcoal averaging sil. 1.50, delivered at Chicago.. | | $29.15 |
| Northern coke, No. 1, sil. 2.25 to 2.75 | $23.50 to | 24.00 |
| Northern coke, foundry, No. 2, sil. 1.75 to 2.25 | 23.00 to | 23.50 |
| Malleable, not over 2.25 sil | 23.00 to | 23.50 |
| Basic | 23.00 to | 23.50 |
| High phosphorus | 23.00 to | 23.50 |
| Southern No. 2 | | 27.01 |
| Low phos., sil. 1 to 2 per cent, copper free | 34.00 to | 34.79 |
| Silvery, sil. 8 per cent | | 37.29 |

**Ferroalloys.**—Demand for ferroalloys has been confined to carload lots. A sale of a carload of ferromanganese brought $109, f.o.b. New Orleans. Another carload brought $1 higher. A carload of spiegeleisen was purchased at $39, Eastern furnace, or $47.58 delivered.

We quote 80 per cent ferromanganese, $116.56 to $117.56, delivered; 50 per cent ferrosilicon, $75, delivered; spiegeleisen, 18 to 22 per cent, $47.58 to $48.58, delivered.

**Plates.**—The Southern Pacific has distributed orders for 5480 cars and will build 1075 cars in its own shops, making a total of 6555 cars, involving 65,000 tons of steel. Most of this equipment will be built in Western plants and it is assumed that the steel will be furnished by local mills. Chicago producers have taken a considerable tonnage of car steel during the past month and are also receiving more liberal orders from other sources. No oil storage tank buying, however, is reported. Prices on plates are firm at 2.60c., Chicago.

The mill quotation is 2.60c., Chicago. Jobbers quote 3.30c. for plates out of stock.

**Bars.**—Forward buying has assumed substantial proportions and specifications are heavier than is usual at this time of the year. Liberal orders have been placed by the automotive industry, as well as by miscellaneous manufacturers and jobbers. Even the farm implement industry, which has been operating at a low rate throughout the year, is taking a hopeful view of the future. Soft steel bars are firm at 2.50c., Chicago. Demand for rail steel bars is improving and one producer hopes to go on double turn some time in January. Liberal seasonal purchases of fence posts have been reflected in heavier orders for rail steel. Buying of iron has improved less than demand for other bar products.

Mill prices are: Mild steel bars, 2.50c., Chicago; common bar iron, 2.40c., Chicago; rail steel, 2.30c., Chicago mill.

Jobbers quote 3.20c. for steel bars out of warehouse. The warehouse quotation on cold-rolled steel bars and shafting is 4c. for rounds and 4.50c. for flats, squares and hexagons.

Jobbers quote hard and medium deformed steel bars at 2.75 to 3c. base; hoops, 4.45c.; bands, 3.95c.

**Structural Material.**—The building outlook is steadily improving, and in this city alone, large projects, involving over $100,000,000, are in immediate prospect. The assembly plant of the Ford Motor Co. at St. Paul, Minn., 6000 tons, has finally been awarded to the Minneapolis Steel & Machinery Co. and the St. Paul Foundry Co. Fabricators have accumulated more comfortable bookings and are now quoting higher figures on new work. Plain material prices are unchanged.

The mill quotation on plain material is 2.60c., Chicago. Jobbers quote 3.30c. for plain material out of warehouse.

**Rails and Track Supplies.**—A local mill has booked orders for 25,000 tons of rails and the necessary track supplies, amounting to approximately 6300 tons. An unusually heavy tonnage of rails, fully 75,000 tons, has been released against contracts for rolling. Miscellaneous demand for track supplies is good, but light rails remain quiet.

Standard Bessemer and open-hearth rails, $43; light rails, rolled steel, 2.25c., f.o.b. makers' mills.

Standard railroad spikes, 3.10c. mill; track bolts with square nuts, 4.10c. mill; steel tie plates, 2.60c., f.o.b. mill; angle bars, 2.75c., f.o.b. mill.

Jobbers quote standard spikes out of warehouse at 3.75c. base, and track bolts, 4.75c. base.

**Bolts and Nuts.**—Demand for bolts and nuts has not revived in a degree comparable with the increased interest shown in other steel products. Consumers bought heavily when prices were lower and are fairly well supplied for the time being. Sellers look forward hopefully, however, to first quarter and are steadily closing contracts for that period.

Jobbers quote structural rivets, 3.75c.; boiler rivets, 3.95c.; machine bolts up to ⅝ x 4 in., 55 and 5 per cent off; larger sizes, 55 and 5 off; carriage bolts up to ⅝ x 6 in., 50 and 5 off; larger sizes, 50 and 5 off; hot pressed nuts, squares and hexagons, tapped, $3.50 off; blank nuts, $3.50 off; coach or lag screws, gimlet points, square heads, 60 and 5 per cent off.

**Cast Iron Pipe.**—Omaha, Neb., has placed 3000 tons with the National Cast Iron Pipe Co. One-half of the tonnage was De Lavaud centrifugal pipe. An Indianapolis public utility has awarded 4300 tons to the leading interest. The Detroit City Gas Co. is understood to have purchased 12,000 tons from the same maker. The Lynchburg Foundry Co. is low bidder on 585 tons for Spring Wells, Mich. The Union Pacific Railroad has placed 1200 tons with the United States Cast Iron Pipe & Foundry Co. The same maker will furnish 500 tons for Bellwood, Ill.

We quote per net ton, f.o.b. Chicago, as follows: Water pipe, 4-in., $59.20 to $60.20; 6-in. and above, $55.20 to $56.20; class A and gas pipe, $5 extra.

**Sheets.**—Consumers are no longer delaying their purchases and buying is in excellent volume. One local producer is committed to the extent of 65 to 75 per cent of its first quarter output. Shading has practically disappeared and the Steel Corporation figures now represent the ruling market on all forms of sheets, with the possible exception of black, on which 3.75c., base, Pittsburgh, is still being done by a few mills.

Mill quotations are 3.75c. to 3.85c. for No. 28 black, 3c. for No. 10 blue annealed and 5c. for No. 28 galvanized, all being Pittsburgh prices, subject to a freight rate to Chicago of 34c. per 100 lb.

Jobbers quote, f.o.b. Chicago, 4c. for blue annealed, 4.70c. for black and 5.85c. for galvanized.

**Wire Products.**—Forward business is developing in increasing volume, although mills are still in a position to ship rather promptly. Thus far manufacturing users have bought more liberally than jobbers. Prices, which are unchanged, are shown on page 134.

We quote warehouse prices f.o.b. Chicago: No. 6 to No. 9 bright basic wire, $3.90 per 100 lb.; extra for black annealed wire, 15c. per 100 lb.; common wire nails, $3.80 per 100 lb.; cement coated nails, $3.25 per keg.

**Old Material.**—Although an independent steel works has closed for several thousand tons of heavy melting at $17 per gross ton delivered, buying by the Steel Corporation has failed to materialize and none is in prospect from that source. The market has consequently weakened and prices on a considerable number of grades of scrap are lower. Consumer buying has been confined principally to scattered purchases of malleable and machinery casts. A fair demand for rerolling rails, however, is looked for. Iron mill grades are quiet and there is no demand for low phosphorus steel. Railroad offerings include: Chicago & North Western, 6000 tons; Illinois Central, 4750 tons; Pennsylvania Southwestern Region, 1600 tons; Pennsylvania Northwestern Region, 1700 tons; Chicago, Milwaukee & St. Paul, 1000 tons; Monon, 400 tons; the New York Central and the Big Four, blind lists.

We quote delivery in consumers' yards, Chicago and vicinity, all freight and transfer charges paid, as follows:

| | |
|---|---|
| *Per Gross Ton* | |
| Iron rails | $20.50 to $21.00 |
| Cast iron car wheels | 20.00 to 20.50 |
| Relaying rails, 56 and 60 lb. | 26.00 to 27.00 |
| Relaying rails, 65 lb. and heavier | 32.00 to 35.00 |
| Forged steel car wheels | 20.00 to 20.50 |
| Railroad tires, charging box size | 20.50 to 21.00 |
| Railroad leaf springs, cut apart | 20.50 to 21.00 |
| Rails for rerolling | 18.00 to 18.50 |
| Steel rails, less than 3 ft. | 19.50 to 20.00 |
| Heavy melting steel | 16.75 to 17.25 |
| Frogs, switches and guards cut apart | 16.75 to 17.25 |
| Shoveling steel | 16.50 to 17.00 |
| Drop forge flashings | 12.50 to 13.00 |
| Hydraulic compressed sheets | 13.50 to 14.00 |
| Axle turnings | 14.00 to 14.50 |
| Steel angle bars | 18.50 to 19.00 |
| *Per Net Ton* | |
| Iron angle and splice bars | 21.00 to 21.50 |
| Iron arch bars and transoms | 21.50 to 22.00 |
| Iron car axles | 26.00 to 26.50 |
| Steel car axles | 18.00 to 18.50 |
| No. 1 busheling | 13.50 to 14.00 |
| No. 2 busheling | 8.50 to 9.00 |
| Cut forge | 15.00 to 15.50 |
| Pipes and flues | 11.00 to 11.50 |
| No. 1 railroad wrought | 15.50 to 16.00 |
| No. 2 railroad wrought | 15.00 to 15.50 |
| Steel knuckles and couplers | 18.50 to 19.00 |
| Coil springs | 19.50 to 20.00 |
| No. 1 machinery cast | 20.00 to 20.50 |
| No. 1 railroad cast | 19.00 to 19.50 |
| No. 1 agricultural cast | 19.00 to 19.50 |
| Low phos. punchings | 16.00 to 16.50 |
| Locomotive tires, smooth | 17.50 to 18.00 |
| Machine shop turnings | 9.00 to 9.50 |
| Cast borings | 11.00 to 11.50 |
| Short shoveling turnings | 11.00 to 11.50 |
| Stove plate | 16.50 to 17.00 |
| Grate bars | 16.50 to 17.00 |
| Brake shoes | 17.50 to 18.00 |
| Railroad malleable | 18.00 to 18.50 |
| Agricultural malleable | 18.00 to 18.50 |

**Reinforcing Bars.**—Lettings during the week were heavy, and an increasing amount of work is in prospect. Concessions in prices are still being made down to 2.75c., Chicago warehouse, notably on road work, which, of course, involves little fabrication and calls for material principally in stock lengths. On the whole, however, the market is steadily gathering strength, and it would appear that the 3c., Chicago, price will soon be again firmly established.

Lettings include:

Atchison, Topeka & Santa Fe Railroad office building, Topeka, Kan., 800 tons, to Kansas City Bolt & Nut Co.

Continental Can Co., plant, Chicago, 600 tons, to Olney J. Dean.

Harrison school building, Grand Rapids, Mich., 280 tons, to Joseph T. Ryerson & Son.

Delaware Avenue bridge, Indianapolis, Ind., 200 tons, to Kalman Steel Co.

Water Works, Lansing, Mich., 100 tons, to Concrete Steel Co.

Bethany Girls' Home, Chicago, 100 tons, to Concrete Steel Co.

Pending business includes:

Chicago Tribune Tower, 500 tons, bids on general contract to be taken Jan. 15.

Municipal Water Works, St. Paul, Minn., 410 tons, Clinton Bridge Co., Clinton, Iowa, low bidder.

Libbey-Owens Sheet Glass Co., Toledo, Ohio, plant addition, 325 tons, general contract figures taken Dec. 27.

Indiana road work, 300 tons, general contract figures to be taken Jan. 3.

# Birmingham

## Southern Furnaces Well Supplied with Orders for First Quarter

BIRMINGHAM, ALA., Dec. 31.—Southern furnace interests go into the new year with considerable iron sold for first quarter, the market strong at $21 to $21.50 per ton, No. 2 foundry, base, and inquiries for small lots of iron being received. Smaller interests are asking $22 for immediate delivery iron. Very little iron has been sold into the second quarter, but indications point to need for the product. Production of pig iron for the last month of year will run about 215,000 tons, steady operation of blast furnaces being noted. Many of the iron melting plants in the Birmingham district began resumption of operations the middle of the past week and by the second day of the new year practically all plants which were in operation week before last will be going again. Local melters of iron have started buying in the hand-to-mouth fashion and the base price is $21.50.

We quote per gross ton f.o.b. Birmingham district furnace as follows:

| | |
|---|---|
| Foundry, silicon 1.75 to 2.25 | $21.00 |
| Basic | 21.00 |
| Charcoal, warm blast | 33.00 |

**Cast Iron Pipe.**—Cast iron plants, both gas and water, and the sanitary pipe makers are at work with good business in hand and more in sight. Larger sized pipe in strong demand and indications point to necessity for operation of shops indefinitely. For sanitary pipe (also cast iron) orders are numerous.

4-in. water, $51; 6-in., $47; larger sizes, $46; 4-in. gas, $56; 6-in., $52; standard sanitary pipe, $55; heavy gage, $45.

**Coke.**—Southern coke producers are introducing by-product coke as a domestic fuel and are shipping considerable of the product. The curtailed output in this State will continue for some time though the market is declared somewhat improved.

**Scrap.**—A better condition is reported in old material and some heavy melting steel is selling $15 to $16.50 as minimum price. Yards are well stocked with old material. Railroads are still offering large quantities of old material.

We quote per gross ton f.o.b. Birmingham district yards, nominal prices, as follows:

| | |
|---|---|
| Cast iron borings, chemical | $16.00 |
| Heavy melting steel | 12.00 |
| Railroad wrought | 14.00 |
| Steel axles | 17.00 |
| Iron axles | 20.00 |
| Steel rails | 13.00 |
| No. 1 cast | 18.50 |
| Tram car wheels | 15.50 |
| Car wheels | 15.00 |
| Stove plate | 14.00 |
| Machine shop turnings | 6.00 |
| Cast iron borings | 8.00 |

# New York

## Structural Steel Activity Continues—Telephone Building Taking 18,000 Tons Awarded

NEW YORK, Dec. 31.—Happenings of the last week of 1923 in the local finished steel market were few and of little importance in pointing clearly to the drift of the steel market during the early part of 1924. There is a growing opinion that conditions are becoming more favorable for a good first quarter business, and there is reasonable assurance that this will prove true in such products as tin plate, sheets, pipe and wire products in particular, but in plates and bars the situation is still far from encouraging. In structural shapes there has been a vast improvement in the past month. The activity in structural steel has continued, so far as lettings are concerned, through the holiday week, but there has been a marked falling off in inquiries. Considerable work, however, is still pending and a fair volume of contracting is expected in January, which ordinarily is a quiet month in structural sales, the spring construction demand usually setting in in February. Winter construction work this year, however, has greatly changed the normal course of structural steel activity and the trade does not expect any serious letdown in January. The principal structural letting of the past week was 18,000 tons to Post & McCord and the American Bridge Co. for the new building of the New York Telephone Co. The American Bridge Co. will fabricate 3000 tons for a pier for the City of New York. An Atlantic Coast shipbuilding and car works, which had notified American plate mills that it would probably buy 2700 tons of car plates abroad because of low prices quoted, gave out word a few days ago that the business had been placed with an American mill, but there was no disclosure of the name of the mill or the price paid. English and French steel has been available for some time at prices considerably under American prices, but our buyers have not been seriously tempted because of previous unsatisfactory dealings abroad. Shapes rolled in England to American specifications are offered at 2.10c., New York or Philadelphia, while French shapes are available at 1.95c., either port. The fact that users of steel here have not been able to depend upon deliveries nor upon the meeting of specifications as closely as is the custom of American mills has caused consumers to pass up foreign tonnage, which on the basis of prices alone might have proved attractive. The New York Central Railroad opened bids last Thursday on miscellaneous steel requirements for first quarter, including up to 5000 tons of plates, up to 5000 tons of shapes and bars, a tonnage of fabricated material for bridges, 500 tons of wire products, 250 tons of billets and axles, wheels, etc. The lowest quotations on plates, shapes and bars were 2.50c., West Seneca. Some other quotations were on the basis of 2.40c., mill, or thereabouts, while quite a number were figured as high as 2.50c., Pittsburgh.

We quote for mill shipments, New York delivery, as follows: Soft steel bars, 2.74c.; plates and structural shapes, 2.74c. to 2.84c.; bar iron, 2.74c.

**Ferroalloys.**—Very few sales or inquiries have been reported in the last week of the year in ferromanganese or in spiegeleisen. These markets are quiet and firm at prevailing quotations and it is expected that with the turn of the year considerable business will develop. Contracts for 50 per cent ferrosilicon at $75, delivered, for 1924 consumption have been fairly liberally made and there have been no other developments in this market. Consumers of ferrochromium have also been placing contracts for next year's needs at prices little changed from those in 1923.

**Pig Iron.**—The year ends with a very quiet pig iron market. The only important inquiries pending recently, those of the Worthington Pump & Machinery Corporation for 2000 tons, and the New York Central for 1500 tons, have not been placed. There is no definite information as to whether they will be closed or withdrawn. Sales of Virginia iron, which have been very limited for a long time, amounted to about 500 tons during the past week. Prices continue on the basis of $23, furnace, eastern Pennsylvania, and $22, Buffalo, but some resale iron can be had at slightly lower quotations.

We quote delivered in the New York district as follows, having added to furnace price $2.27 freight from eastern Pennsylvania, $4.91 from Buffalo and $5.44 from Virginia:

| | |
|---|---|
| East. Pa. No. 1X fdy., sil. 2.75 to 3.25 | $25.77 |
| East. Pa. No. 2X fdy., sil. 2.25 to 2.75 | 25.27 |
| East. Pa. No. 2, sil. 1.75 to 2.25 | 25.27 |
| Buffalo, sil. 1.75 to 2.25 | 26.91 |
| No. 2X Virginia, sil. 2.25 to 2.75 | 30.44 |
| No. 2 Virginia, sil. 1.75 to 2.25 | 29.94 |

**Cast-Iron Pipe.**—A fair volume of inquiry for delivery next spring is appearing, but otherwise the market is quiet. We quote per net ton, f.o.b. New York, in carload lots, as follows: 6-in. and larger, $61.60 to $63.60; 4-in. and 5-in., $66.60 to $68.60; 3-in., $76.60 to $78.60, with $5 additional for Class A and gas pipe. Soil pipe discounts are unchanged and the market quiet, with most makers booked well into January and jobbers evidently well stocked for the present, having covered at low prices. Should the open weather of the past few months continue through January, makers look forward to an earlier spring demand than usual, as stocks would undoubtedly be reduced by the demands from construction work. We quote discounts of both Southern and Northern makers, f.o.b. New York, in carload lots, as follows: 6-in., 29½ to 35¾ per cent off list; heavy, 39½ to 45¾ per cent off list.

**Warehouse Business.**—The market has been quiet in general, although warehouses carrying structural material report a fairly active demand, as a result of the building construction proceeding during the present open weather. A fair volume of inquiry in some products is noted, which may develop into activity early in January. The sheet market, although dull this week, has held firm and sellers seem to expect greater firmness in the coming weeks. Pipe warehouses also report present quiet but fairly active inquiry for future delivery. We quote prices on page 140.

**Coke.**—Some weakness has developed and tonnages are reported available at lower prices than have been current recently. Standard foundry ranges from $5 to $5.50 per ton for prompt shipment and standard furnace is about $3.75 to $4.25 per ton, with medium phosphorus at about $3.50 per ton. By-product is quoted at $10.91, Newark and Jersey City, N. J.

**Old Material.**—Prices are holding firm and with a distinct upward tendency on many grades. No. 1 heavy melting steel and railroad quality as well are quoted at $17 per ton, eastern Pennsylvania delivery. In some instances slightly higher offers have been made by brokers covering on contracts. As high as $13.50 per ton has been quoted on borings and turnings delivered to an eastern Pennsylvania consumer. Stove plate is firm at $16.50, delivered either to a Harrisburg consumer or to New Jersey foundries. Specification pipe is quotable at $16 to $16.50, eastern Pennsylvania delivery. No. 1 railroad wrought shows an advance of about $1 per ton.

Buying prices per gross ton New York follow:

| | |
|---|---|
| Heavy melting steel, yard | $13.00 to $13.50 |
| Steel rails, short lengths, or equivalent | 13.75 to 14.25 |
| Rails for rolling | 15.00 to 16.00 |
| Relaying rails, nominal | 25.00 to 26.00 |
| Steel car axles | 16.00 to 17.00 |
| Iron car axles | 24.00 to 24.50 |
| No. 1 railroad wrought | 14.50 to 15.00 |
| Forge fire | 10.00 to 10.50 |
| No. 1 yard wrought, long | 12.00 to 12.50 |
| Cast borings (clean) | 10.00 to 10.50 |
| Machine-shop turnings | 10.50 to 11.00 |
| Mixed borings and turnings | 9.25 to 9.75 |
| Iron and steel pipe (1 in. diam., not under 2 ft. long) | 12.25 to 12.75 |
| Stove plate | 12.50 to 13.50 |
| Locomotive grate bars | 12.50 to 13.00 |
| Malleable cast (railroad) | 14.00 to 15.00 |
| Cast-iron car wheels | 15.00 to 15.50 |

Prices which dealers in New York and Brooklyn are quoting to local foundries per gross ton follow:

| | |
|---|---|
| No. 1 machinery cast | $19.00 |
| No. 1 heavy cast (columns, building materials, etc.), cupola size | 18.00 |
| No 1 heavy cast, not cupola size | 14.50 |
| No. 2 cast (radiators, cast boilers, etc) | 16.00 |

# Philadelphia

## Last Week of 1923 Unusually Quiet, but Confidence in Outlook Is Growing

PHILADELPHIA, Jan. 1.—The last week of 1923 brought no developments of moment in iron and steel markets. It was, in fact, one of the quietest weeks of the year. As this situation is not unusual for the holiday week, no importance was attached to it in the trade. In steel products other than plates, the month of December brought more new tonnage to the mills than either October or November and steel companies derive considerable encouragement from that fact, also from the fact that a few consumers have voluntarily taken out first quarter contracts in some lines, particularly sheets, cold-finished steel, wire products, hot and cold rolled strip and soft steel bars. Such tonnages are not large, but there has been little haggling over prices, the mills having generally impressed buyers with their determination to make no reductions. Even in plates and shapes, in which concessions have been most conspicuous, there is more of a tendency to hold firmly to quoted prices. The pig iron market has been exceedingly dull and the advance in old material prices has been at least temporarily checked.

**Pig Iron.**—Sales of pig iron in the past week have been small, mostly carload lots of foundry grades. Prices are firm on the basis of $23, furnace, for No. 2 plain. There is no demand for basic, but quotations would probably be about $22 to $22.50, furnace. Malleable is generally quoted at $23.50, furnace.

The following quotations are, with the exception of those on low phosphorus iron, for delivery at Philadelphia and include freight rates varying from 76 cents to $1.63 per gross ton:

| | |
|---|---|
| East. Pa. No. 2 plain, 1.75 to 2.25 sil. | $23.76 to $24.13 |
| East. Pa. No. 2X, 2.25 to 2.75 sil. | 24.26 to 24.63 |
| East. Pa. No. 1X | 24.76 to 25.13 |
| Virginia No. 2 plain, 1.75 to 2.25 sil. | 29.17 to 30.17 |
| Virginia No. 2X, 2.25 to 2.75 sil. | 30.17 to 30.67 |
| Basic delivery eastern Pa. | 23.25 to 23.50 |
| Gray forge | 23.00 to 23.50 |
| Malleable | 24.25 to 24.50 |
| Standard low phos. (f.o.b. furnace) | 27.50 to 28.00 |
| Copper bearing low phos. (f.o.b. furnace) | 28.00 |

**Ferroalloys.**—Domestic ferromanganese remains at $109, furnace, and British at $110, seaboard.

**Semi-Finished Steel.**—First quarter contracts for billets have been closed at $40, Pittsburgh, for rerolling quality and at $45, Pittsburgh, for forging quality.

**Plates.**—Plate production in Eastern mills has been greatly curtailed during the past week, some of the mills having been shut down the entire week. Operations will be begun again this week, some companies having accumulated a little tonnage during the past several days. Prices usually quoted range from 2.40c. to 2.50c., Pittsburgh.

**Structural Material.**—One steel company which operates a fabricating shop has dropped out of the market on all fabricated material, having sold enough tonnage to engage its shop capacity for the next few months. The mill situation on shapes is improving. Plain material is still available at from 2.35c. to 2.50c., Pittsburgh, the price depending on the mill and the character and size of the rolling.

**Bars.**—Aside from a few small steel bar contracts for first quarter, the market is inactive, but prices are holding at 2.40c., Pittsburgh. Bar iron is available at 2.30c., Pittsburgh, with the demand only fair.

**Sheets.**—An Eastern mill rolling blue annealed sheets has closed a number of contracts in the past week with regular customers for their first quarter supply. The price in every instance is stated to have been 3c., Pittsburgh. Prices on galvanized and black sheets on contracts are also being held to more rigidly than was the case recently.

**Warehouse Business.**—During the inventory days, consumers have been calling upon the jobbers for small lots to fill out the year's requirements, with the result that local warehouses have enjoyed a very satisfactory demand in the holiday period. Prices are unchanged, for local delivery being as follows:

Soft steel bars and small shapes, 3.47c.; iron bars (except bands), 3.47c.; round edge iron, 3.75c.; round edge steel, iron finished, 1½ x ½ in., 3.75c.; round edge steel planished, 4.55c.; tank steel plates, ¼ in. and heavier, 3.57c.; tank steel plates, $\frac{3}{16}$ in., 3.82c.; blue annealed steel sheets, No. 10 gage, 4.10c.; black sheets, No. 28 gage, 5.15c.; galvanized sheets, No. 28 gage, 6.25c.; square twisted and deformed steel bars, 3.57c.; structural shapes, 3.57c.; diamond pattern plates, ¼-in., 5.40c.; $\frac{3}{16}$-in., 5.60c.; spring steel, 5c.; round cold-rolled steel, 4.35c.; squares and hexagons, cold-rolled steel, 4.85c.; steel hoops, 1 in. and wider, No. 20 gage and heavier, 4.27c.; narrower than 1 in., all gages, 4.77c.; steel bands, No. 12 gage to $\frac{1}{16}$-in., inclusive, 4.27c.; rails, 3.47c.; tool steel, 8.50c.; Norway iron, 7c.

**Old Material.**—There has been less activity in the scrap market the past week and the advance in prices, which has been steady over a period of several weeks, has been at least temporarily checked. The scrap trade is confident, however, that higher prices will be reached early in the new year. No. 1 cast scrap is slightly easier, sales having been made at $20.50 and $21, delivered. Blast furnace borings and turnings are slightly higher at $12.50 to $13, delivered.

We quote for delivery at consuming points in this district as follows:

| | |
|---|---|
| No. 1 heavy melting steel | $17.50 |
| Scrap rails | 17.50 |
| Steel rails for rolling | 19.00 to 19.50 |
| No. 1 low phos., heavy 0.04 and under | 22.00 to 23.00 |
| Couplers and knuckles | 20.00 to 21.00 |
| Cast-iron car wheels | 19.50 to 20.00 |
| Rolled steel wheels | 20.00 to 21.00 |
| No. 1 railroad wrought | 19.00 to 19.50 |
| No. 1 yard wrought | 17.50 to 18.50 |
| No. 1 forge fire | 15.00 |
| Bundled sheets (for steel works) | 15.00 |
| Mixed borings and turnings (for blast furnace use) | 12.50 to 13.00 |
| Machine shop turnings (for steel works use) | 15.00 |
| Machine shop turnings (for rolling mill use) | 15.00 to 15.50 |
| Heavy axle turnings (or equivalent) | 15.50 to 16.00 |
| Cast borings (for steel works and rolling mills) | 14.00 to 14.50 |
| Cast borings (for chemical plants) | 16.00 to 17.00 |
| No. 1 cast | 20.50 to 21.00 |
| Heavy breakable cast (for steel plants) | 18.00 to 19.00 |
| Railroad grate bars | 17.00 to 18.00 |
| Stove plate (for steel plant use) | 17.00 to 18.00 |
| Railroad malleable | 18.50 to 19.00 |
| Wrought iron and soft steel pipes and tubes (new specifications) | 17.00 to 17.50 |
| Shafting | 24.00 to 25.00 |
| Steel axles | 23.00 to 24.00 |

# Buffalo

## Little Activity Except in Shipping—Confidence as to First Quarter of 1924

BUFFALO, Dec. 31.—Except for brisk shipping instructions on contracts made in the November buying movement, little has engaged producers and sellers in the closing weeks of the year. Total sales are under 2000 tons but such small tonnages as were moved were at satisfactory prices. Complete confidence in at least first quarter of 1924 is generally expressed; the predominant feeling is that melting will be on a large scale and that present strong prices will hold. It is not believed that any buying will take place in January except isolated tonnages for melters who did not place business at the low figures quoted late in November and December.

We quote f.o.b., gross ton, Buffalo, as follows:

| | |
|---|---|
| No. 1 foundry, sil. 2.75 to 3.25 | $23.00 |
| No. 2 foundry, sil. 2.25 to 2.75 | 22.50 |
| No. 2 plain, sil. 1.75 to 2.25 | 22.00 |
| Basic | 22.00 |
| Malleable | 22.00 |
| Lake Superior charcoal | 29.28 |

**Finished Iron and Steel.**—All producers and sellers found little in the last week of the year to engage attention. Prices hold firm, but no new business of consequence was inquired for and the holiday lull was even more pronounced than in former years.

We quote warehouse prices Buffalo as follows: Structural shapes, 3.65c.; plates, 3.65c.; soft steel bars, 3.55c.; hoops, 4.65c.; bands, 4.35c.; blue annealed sheets, No. 10 gage, 4.30c.; galvanized steel sheets, No. 28 gage, 6.10c.; black sheets, No. 28 gage, 5c.; cold rolled round shafting, 4.45c.

**Old Material.**—Good demand outside the Buffalo district, particularly in the Pittsburgh and Youngstown districts, is not apparent here, but dealers are generally confident that several big tonnages of heavy melting steel will be bought early in January. Prices are strong and the week's quietness is the usual holiday indifference.

We quote f.o.b., gross ton, Buffalo, as follows:

| | |
|---|---|
| Heavy melting steel | $17.50 to $18.00 |
| Low phos., 0.04 and under | 20.00 to 21.00 |
| No. 1 railroad wrought | 14.00 to 15.00 |
| Car wheels | 18.00 to 18.50 |
| Machine shop turnings | 10.00 to 11.00 |
| Cast iron borings | 12.50 to 13.00 |
| No. 1 busheling | 14.00 to 15.00 |
| Stove plate | 17.00 to 17.25 |
| Grate bars | 16.00 to 16.50 |
| Bundled sheet stampings | 10.00 to 11.00 |
| Hydraulic compressed | 14.00 to 14.50 |
| Railroad malleable | 19.50 to 20.50 |
| No. 1 machinery cast | 19.50 to 20.50 |

# Boston

## Year Goes Out with Little Interest Shown in Pig Iron

BOSTON, Dec. 31.—The year goes out with little interest being shown by foundries in pig iron, sales for the past week being confined to a car here and there at previously reported prices. Sentiment in the market is optimistic, however. It is believed foundries are still short many thousand tons for first quarter requirements, and it has been intimated that others will buy for second quarter as soon as furnaces open their books. Estimates of the 1923 New England melt of iron run from 10 to 20 per cent above the 1922 consumption. The melt unquestionably would have been larger had the labor supply been more adequate. Stove, heater and textile machinery makers, with books plugged with business most of the year, attracted molders from other industries as well as from jobbing foundries.

We quote delivered prices on the basis of the latest reported sales as follows, having added $3.65 freight from eastern Pennsylvania, $4.91 from Buffalo, $5.92 from Virginia, and $9.60 from Alabama:

| | |
|---|---|
| East. Penn., sil. 2.25 to 2.75 | $27.15 |
| East. Penn., sil. 1.75 to 2.25 | 26.65 |
| Buffalo, sil. 2.25 to 2.75 | $26.91 to 27.41 |
| Buffalo, sil. 1.75 to 2.25 | 25.91 to 26.91 |
| Virginia, sil. 2.25 to 2.75 | 30.42 to 32.42 |
| Virginia, sil. 1.75 to 2.25 | 29.92 to 31.92 |
| Alabama, sil. 2.25 to 2.75 | 31.10 |
| Alabama, sil. 1.75 to 2.25 | 30.60 |

**Warehouse Business.**—Due to the open winter, warehouse business in December was far ahead of that for the corresponding month in 1922. Warehouse stocks generally are well assorted, but small. Prices are steady and unchanged.

**Cast Iron Pipe.**—Wellesley, Mass., has covered on its 1924 requirements with the Warren Foundry & Pipe Co., Brockton, Mass., has asked bids on 100 tons New England specification pipe. No other municipalities are in the market at the moment, but several intend to ask bids within the next month or so. For first quarter specifications, foundries hold to $72.10 delivered Boston common rate points for 4-in. pipe, $67.10 for 6-in. to 14-in., inclusive, and $65.10 for 16-in. and larger with $5 differentials on class A and gas pipe. But where prospects will allow foundries to make deliveries within the next three or four weeks, concessions of $1 to 2 are obtainable.

**Coke.**—New England by-product foundry coke producers have announced that the price to apply on January contract shipments is $12.50 delivered in New England, the price ruling throughout December. Specifications against 1923 contracts in the closing days of the year were larger than expected, many foundries stocking up in anticipation of bad weather. More seasonable temperatures have further increased the call for domestic coke, consequently the New England Coal & Coke Co. and the Providence Gas Co. turned the year with unfilled orders for fuel on their books. Little, if any, interest is shown in Connellsville cokes. The spread in prices for such foundry cokes and New England product of equal grade is smaller than it has been in months.

**Old Material.**—Although less active, the market is firmer in anticipation of brisk business after the turn of the year. Heavy melting steel is the most active material on the list, purchases being made for shipment to eastern Pennsylvania as well as to Weirton. For eastern Pennsylvania shipment, the market is approximately 25c. a ton higher, but for Weirton, where the freight rate has been advanced from $5.53 to $5.70, dealers are deducting the difference in the carrying charges. For instance, dealers heretofore paying $13 on cars shipping point, now pay $12.80. Several hundred tons of specification wrought pipe at $12 on cars figure in recent business closed. Steel turnings at $9.50 to $10, mostly $10, chemical borings at $11, $11.50 and in at least one instance $12, and mixed borings and turnings at $9 and $9.25, also are included in transactions. Otherwise materials have been moved sparingly.

The following prices are for gross ton lots delivered consuming points:

| | |
|---|---|
| No. 1 machinery cast | $22.00 to $23.00 |
| No. 2 machinery cast | 20.00 to 21.00 |
| Stove plates | 16.00 to 16.50 |
| Railroad malleable | 17.50 to 18.00 |

The following prices are offered per gross ton lots f.o.b. Boston rate shipping points:

| | |
|---|---|
| No. 1 heavy melting steel | $13.25 to $13.75 |
| No. 1 railroad wrought | 14.50 to 15.00 |
| No. 1 yard wrought | 12.50 to 13.00 |
| Wrought pipe (1-in. in. diam., over 2 ft. long) | 11.50 to 12.00 |
| Machine shop turnings | 9.50 to 10.00 |
| Cast iron borings, chemical | 11.00 to 11.50 |
| Cast iron borings, rolling mill | 9.50 to 10.00 |
| Blast furnace borings and turnings | 9.00 to 9.25 |
| Forged scrap and bundled skeleton | 9.50 to 10.00 |
| Shafting | 17.50 to 18.00 |
| Street car axles | 17.50 to 18.00 |
| Rails for rolling | 14.00 to 14.50 |

# Cincinnati

## Sale of Foundry Iron Principal Business of Quiet Holiday Week

CINCINNATI, Dec. 31.—The pig iron market was quiet during the holiday week and sales generally were confined to carload lots. There was, however, a sale of 3500 tons of foundry iron to a melter in this district, the price being $22.50, base, Ironton. Southern irons were inactive though prices continue strong. Reports from the South indicate that there will be a shortage of the lower silicon grades during the first quarter. Silveries, charcoal and basic irons are not in demand. Indications of good business are seen in the numerous requests to hurry shipments and the fact that foundries in the district report an increasing demand for castings. It is expected that next week will see an improvement in buying, as foundries generally are not covered fully for their estimated requirements for first quarter.

Based on freight rates of $4.05 from Birmingham and $2.27 from Ironton we quote f.o.b. Cincinnati:

| | |
|---|---|
| Southern coke, sil. 1.75 to 2.25 (base) | $25.05 |
| Southern coke, sil. 2.25 to 2.75 (No. 2 soft) | 25.55 |
| Ohio silvery, 8 per cent | 34.77 |
| Southern Ohio coke, sil. 1.75 to 2.25 (No. 2) | 24.77 |
| Basic Northern | 24.77 |
| Malleable | 24.77 |

**Finished Materials.**—The week has been rather quiet, as far as orders are concerned, but a number of fair-sized inquiries are current, and it is expected that business will pick up substantially after the turn of the year. Bars, shapes and plates are firming up, and some of the smaller mills which had been quoting 2.35c. and 2.40c. respectively for December shipment have come up to the regular market level. Some shading of prices in wire nails is reported, but this is gen-

erally confined to roofing nails. Wire products are in fair demand, and some contracts are being made for first quarter. Some fair-sized orders have been placed for cold-finshed materials, the price being fairly steady at 3c., base, with Pittsburgh district mills equalizing freights into this territory to meet competition of Chicago producers. Steel pipe is in good demand. The Big Four Railroad is expected to come into the market shortly for its 1924 requirements of track accessories, estimated unofficially to be upward of 8000 tons.

**Reinforcing Bars.**—Some fair sized inquiries are current, the largest being for approximately 600 tons required for the new Kentucky Hotel at Louisville. Several range from 100 to 200 tons. An inquiry is current for 500 tons for first quarter shipment. Prices generally are unchanged from last week, the range being 2.20c. to 2.40c., mill.

**Structural Material.**—A number of large inquiries are current, including a warehouse for the L. & N. Railroad, 1300 tons, bids on which close Jan. 7; a machine shop for the same road at Etowah, Tenn., bids on which close Dec. 31; U. S. Engineers' Office, Louisville, steel work on Ohio River dams, 800 tons, bids in; several assembling plants for the Ford Motor Co., involving approximately 6000 tons. The Kentucky Hotel at Louisville is expected to come up for bids this week. Revised plans call for 1300 tons of steel. Awards include 650 tons for the West Virginia State office building at Charleston, to G. A. Fuller Co.

**Sheets and Tin Plate.**—Practically all tin mill capacity is booked for first half of the year, and sheet mills are said to have quietly accumulated substantial order books for first quarter. Some of the smaller mills still need sheet business, however, and concessions of $2 per ton can be obtained.

**Warehouse Business.**—Local jobbers report a healthy increase in orders during the past week, indicating an unusually low stock in plants of manufacturers. Prices are unchanged.

Cincinnati jobbers quote: Iron and steel bars, 3.50c.; reinforcing bars, 3.60c.; hoops, 4.55c.; bands, 4.25c.; shapes, 3.60c.; plates, 3.60c.; cold-rolled rounds, 4.10c.; cold-rolled flats, squares and hexagons, 4.60c.; No. 10 blue annealed sheets, 4.10c.; No. 28 black sheets, 4.80c.; No. 28 galvanized sheets, 5.85c.; No. 9 annealed wire, $3.60 per 100 lb.; common wire nails, $3.50 per keg base; cement coated nails, $3.30 per keg.

**Coke.**—The week was a dull one in the coke trade; although a slight improvement was noted in the demand for domestic grades. Prices, if anything, are firmer, in that the low prices have disappeared, except for distressed tonnage. We quote:

Connellsville furnace, $4.00; foundry, $5.00 to $6.50; New River foundry, $10.00 to $11.00; Wise County furnace, $5.00 to $6.00; foundry, $5.75 to $7.00; by-product foundry, $8.00, Connellsville basis.

**Old Materials.**—Steel plants in this district are showing interest in the market, and one of them is actively inquiring for heavy melting steel. Cast iron borings are also in good demand, as is busheling. Prices generally are higher, the range of advances being from 50c. to $1.00 per ton. There has been some activity in the South, and a number of good inquiries are being figured on by local dealers.

We quote dealers' buying prices, f.o.b. cars Cincinnati:

| | |
|---|---|
| *Per Gross Ton* | |
| Bundled sheets | $12.00 to $12.50 |
| Iron rails | 15.50 to 16.00 |
| Relaying rails, 50 lb. and up | 29.50 to 30.00 |
| Rails for rolling | 15.50 to 16.00 |
| Heavy melting steel | 15.50 to 16.00 |
| Steel rails for melting | 15.00 to 15.50 |
| Car wheels | 15.00 to 15.50 |
| *Per Net Ton* | |
| No. 1 railroad wrought | 13.50 to 14.00 |
| Cast borings | 11.50 to 12.00 |
| Steel turnings | 10.50 to 11.00 |
| Railroad cast | 16.00 to 16.50 |
| No. 1 machinery cast | 19.00 to 19.50 |
| Burnt scrap | 13.00 to 13.50 |
| Iron axles | 28.50 |
| Locomotive tires (smooth inside) | 15.00 to 15.50 |
| Pipes and flues | 10.00 to 10.50 |

# Cleveland

## Decided Improvement in Feeling—Active Buying by Automobile Companies

CLEVELAND, Dec. 31.—The new year will start with a decided improvement in feeling in the steel industry, due to the better volume of business recently booked and to the brighter prospects for 1924. Good mill operations appear assured through at least the first quarter. Buyers seem to have confidence in the market and feel that present prices will hold. Business has continued active in spite of the holiday period. Considerable tonnage was booked during the week, largely in steel bars for the first quarter. While the bulk of contracts came from the automotive industry, the business was well scattered. In addition to getting liberal specifications for first quarter contracts, mills have been securing specifications on old low price contracts and are now getting these contracts well cleaned up. One mill during the week secured releases of several lots of bars held up during the last half aggregating 1000 tons. Consumers who are not placing contracts for the first quarter are buying more freely and in larger lots than they have recently. The Great Lakes Engineering Works, Detroit, has taken a freight boat from an unnamed interest requiring 5000 tons of plates and structural material and another large lake boat may be placed this week. The demand for plates has improved, but prices have not strengthened, still ranging from 2.40c. to 2.50c. In structural lines considerable work is expected to come out in January. An Ohio fabricator is now figuring on railroad bridge work aggregating 3000 tons. The larger automobile companies have covered for their alloy steel requirements for the first quarter and mills specializing in alloy steel are comfortably filled for that delivery. Among late orders is one for 1000 tons of alloy steel bars placed by an Ohio bolt and nut manufacturer.

Jobbers quote steel bars, 3.36c.; plates and structural shapes, 3.46c.; No. 28 black sheets, 4.40c. to 4.65c.; No. 28 galvanized sheets, 5.60c. to 5.80c.; No. 10 blue annealed sheets, 3.60c. to 4c.; cold rolled rounds, 3.90c.; flats, squares and hexagons, 4.40c.; hoops and bands, 1 in. and wider and 20 gage or heavier, 4.16c.; narrower than 1 in. or lighter than No. 20 gage, 4.66c.; No. 9 annealed wire, $3.50 per 100 lb.; No. 9 galvanized wire, $3.95 per 100 lb.; common wire nails, $3.60 base per 100 lb.

**Pig Iron.**—Sales were light during the week but about as much business came out as could be expected during the holiday season. One producer sold 2000 tons of foundry and malleable iron, including one 600-ton lot purchased by an Indiana foundry which had previously partly covered for its first quarter requirements. Other sales in these grades were few in number and confined to small lots. Lake furnace prices are unchanged at $22.50 to $23 for foundry and malleable iron. Cleveland furnaces quote $22.50 at furnace for both local delivery and for outside shipment. Prices in the Valley district range from $22.00 to $22.50. Low phosphorus iron has become somewhat more active and Eastern furnaces do not appear to be as keen competitors for business in this district as they were recently when one producer went to $25 or lower for Central Western business. A Valley furnace during the week sold 1300 tons of low phosphorus iron, including one 500-ton lot, all $29.50, and an inquiry is pending from a Wheeling, W. Va., consumer for 1000 to 1500 tons. The New York Central Railroad has purchased 800 tons of foundry iron for the first quarter from a western New York furnace at $22.50 for No. 2 with a 50c. differential for higher and lower silicon. Inquiries include one for 1000 tons and one for 500 tons, both from Erie. We note the sale of two lots of Southern charcoal iron aggregating 800 tons

in the Pittsburgh district at $32, Birmingham. Southern foundry iron is unchanged at $21.

Quotations below, except on basic and low phosphorus iron, are delivered Cleveland, and for local iron include a 50c. switching charge. Ohio silvery and Southern iron prices are based on a $3.02 freight rate from Jackson and $6 rate from Birmingham:

| | |
|---|---|
| Basic, Valley furnace | $21.00 |
| Northern No. 2 fdy., sil. 1.75 to 2.25 | 23.00 |
| Southern fdy., sil. 1.75 to 2.25 | 27.00 |
| Malleable | 23.00 |
| Ohio silvery, 8 per cent | 35.52 |
| Standard low phos., Valley furnace | $29.00 to 30.00 |

**Sheets.**—Buying has continued in fairly good volume, particularly by the automobile industry. While some consumers are placing orders only for early requirements, many have placed first quarter contracts. Among the late buyers of large tonnages were a large automobile manufacturer and a leading automobile body builder. Automobile body sheets are firm at 5.35c. and prices on other grades are firmer, although plate mills are still quoting No. 10 gage at 2.90c.

**Reinforcing Bars.**—The Bourne-Fuller Co. has taken 120 tons for a factory addition for the Horsburgh & Scott Co., Cleveland, and an inquiry has come out for 150 tons for the Prospect Avenue garage. Soft steel reinforcing bars are still being offered at 2.30c. for rail steel bars at 2.10c.

**Semi-Finished Steel.**—Several consumers who recently contracted with local mill for sheet bars for the first quarter have inquired for additional tonnages, but this producer is sold up for that delivery and can make no further commitments. Sheet bars are firm at $42.50. Forging billets lack firmness for prompt shipment. On a local inquiry one mill quoted $44, but the business was placed at around $42.50, Pittsburgh.

**Bolts, Nuts and Rivets.**—Automobile manufacturers have been buying bolts and nuts liberally and a good volume of inquiry is pending from that and other sources. Considerable business came out during the week in specifications on last quarter contracts. Prices are firm at regular discounts. Rivet specifications have improved. Some first quarter business is still being placed at regular prices, which are firm.

**Coke.**—Some contracts were placed during the week for Connellsville foundry coke for the first quarter at $6.25 to $6.50 for standard makes, although some makes can be purchased at lower prices. Quotations on spot shipment Connellsville foundry coke range from $5 to $6.50.

**Old Material.**—Purchases of machine shop turnings were made during the week by a local plant at $14 and additional lots are under negotiation. A Steubenville consumer is reported to have paid as high as $20 for heavy melting steel. Prices have advanced 25c. to 50c. a ton on several grades and the market continues very firm, but the activity is largely confined to covering by dealers on short sales. Owing to the recent heavy buying, the supply of heavy melting steel has become scarce and dealers are offering $19 for this grade for Valley shipment. For Cleveland delivery, dealers are paying $14.50 for borings and turnings, $13.50 to $13.75 for machine shop turnings and $17 and higher for heavy melting steel. A report that the American Steel & Wire Co. had sent out an inquiry for blast furnace scrap is denied by that company.

We quote dealers' prices f.o.b. Cleveland per gross ton:

| | |
|---|---|
| Heavy melting steel | $16.75 to $17.00 |
| Rails for rolling | 18.00 to 18.25 |
| Rails under 3 ft | 18.00 to 18.50 |
| Low phosphorus melting | 20.00 to 20.50 |
| Cast borings | 13.75 to 14.25 |
| Machine shop turnings | 13.00 to 13.25 |
| Mixed borings and short turnings | 14.00 to 14.25 |
| Compressed sheet steel | 15.00 to 15.25 |
| Railroad wrought | 15.75 to 16.25 |
| Railroad malleable | 20.00 to 20.50 |
| Light bundled sheet stampings | 12.25 to 12.50 |
| Steel axle turnings | 14.50 to 15.00 |
| No. 1 cast | 21.00 to 22.00 |
| No. 1 busheling | 13.25 to 14.00 |
| Drop forge flashings | 13.25 to 13.50 |
| Railroad grate bars | 18.50 to 19.00 |
| Stove plate | 18.50 to 19.00 |
| Pipes and flues | 13.50 to 13.75 |

# St. Louis

## Old Material Furnishes Almost the Only Activity of the Market

St. Louis, Dec. 31.—It is doubtful whether more than 1000 tons of pig iron was sold in this market during the last week. Of the sales, 600 tons was made by the St. Louis Coke & Iron Co., of which 300 tons went to a Texas melter. The Granite City makers are quoting $24 to $25 f.o.b. furnace, while Northern iron is still quoted at $23 to $23.50 Chicago, and Southern $21. There are no inquiries before the market, melters preferring to wait until after the holidays before entering the market.

We quote delivered consumers' yards, St. Louis, as follows, having added to furnace prices $2.16 freight from Chicago, $3.28 from Birmingham (rail and water), $5.17 from Birmingham, all rail, and 81 cents average switching charge from Granite City:

| | |
|---|---|
| Northern fdy., sil. 1.75 to 2.25 | $25.16 to $25.66 |
| Northern malleable, sil. 1.75 to 2.25 | 25.16 to 25.66 |
| Basic | 25.16 to 25.66 |
| Southern fdy., sil. 1.75 to 2.25 (rail) | 26.17 |

**Finished Iron and Steel.**—Because of the holidays, there was virtually no business done in these lines during the last week. Structural fabricators report nothing new of consequence in immediate sight. These interests are "comfortably" situated as far as orders are concerned.

For stock out of warehouse we quote: Soft steel bars, 3.35c. per lb.; iron bars, 3.35c.; structural shapes, 3.45c.; tank plates, 3.45c.; No. 10 blue annealed sheets, 4.10c.; No. 28 black sheets, cold-rolled, one pass, 4.85c.; cold drawn rounds, shafting and screw stock, 4.70c.; structural rivets, 4.15c.; boiler rivets, 4.35c.; tank rivets, $\frac{7}{16}$-in. and smaller, 50-5 per cent off list; machine bolts, 45-5 per cent; carriage bolts, 40-5 per cent; lag screws, 50-5 per cent; hot pressed nuts, squares or hexagon blank, $2.50; and tapped, $2.50 off list.

**Coke.**—The market for coke is dull. Storage piles continue to accumulate, the cause thereof being the mild weather. There is no demand to speak of for domestic grades, and the closing down of some plants over the holidays has caused a decline in the call for industrial grades. Some sales were made during the week to consumers in the zinc fields.

**Old Material.**—Further advances were made in prices for old material during the week. All consumers could not wait for the new year, as they had hoped to be able to do, and some of the larger ones entered the market this week. Several sales of 5000 tons of melting grades were reported. There also is a better demand for rolling mill grades. Dealers continue to bid up prices, and the railroads are getting high prices for their offerings, especially was this true of the recent Chicago Burlington & Quincy list. New lists include: Missouri Pacific, 2500 tons; Pennsylvania System, Central Region, 8000 tons; Southwestern Region, 1600 tons; Northwestern Region, 1700 tons, and Big Four, open.

| | |
|---|---|
| *Per Gross Ton* | |
| Iron rails | $18.00 to $18.50 |
| Rails for rolling | 19.50 to 20.00 |
| Steel rails, less than 3 ft | 20.00 to 20.50 |
| Relaying rails, 60 lb. and under | 25.00 to 26.00 |
| Relaying rails, 70 and over | 32.50 to 33.50 |
| Cast iron car wheels | 19.50 to 20.00 |
| Heavy melting steel | 17.50 to 18.00 |
| Heavy shoveling steel | 17.00 to 17.50 |
| Frogs, switches and guards cut apart | 18.00 to 18.50 |
| Railroad springs | 20.00 to 20.50 |
| Heavy axles and tire turnings | 14.00 to 14.50 |
| *Per Net Ton* | |
| Steel angle bars | 16.00 to 16.50 |
| Steel car axles | 19.50 to 20.00 |
| Iron car axles | 26.00 to 26.50 |
| Wrought iron bars and transoms | 20.00 to 20.50 |
| No. 1 railroad wrought | 15.00 to 15.50 |
| No. 2 railroad wrought | 15.50 to 16.00 |
| Cast iron borings | 11.50 to 12.00 |
| No. 1 busheling | 15.00 to 15.50 |
| No. 1 railroad cast | 18.50 to 19.00 |
| No. 1 machinery cast | 19.00 to 19.50 |
| Railroad malleable | 17.00 to 17.50 |
| Machine shop turnings | 10.50 to 11.00 |
| Champion bundled sheets | 10.00 to 10.50 |

# San Francisco

## Business Fairly Active with Favorable Prospects for the New Year

SAN FRANCISCO, Dec. 26.—While there is some variation of opinion as to the present trade conditions in iron and steel, a careful analysis of the situation makes it safe to say that the business betterment noted several weeks ago still prevails and although there may be a slight curtailment in some few lines, the general position for both the present and the outlook, is better than it was two months ago. Taken as a whole the iron and steel business is fairly active now and there are many indications which tend to give encouragement for the first quarter of the coming year. Prices, while lower than a year ago, are well adhered to and they are more firmly sustained than in some of the other leading lines of industrial activity.

**Pig Iron.**—Importers report a fair measure of current business and the numerous inquiries, not only as to prices, but as to promptness in delivery are all regarded as favorable for an enlarged traffic in the first few months of the coming year. Both mills and foundries are taking materials a little more freely now than a month ago, and as one prominent importer says, they doubtless would purchase more heavily except for the fact that they do not care to carry any more than absolutely necessary prior to the taking of the usual annual inventories. Current quotations show very little variation from the figures of two weeks ago and $33 to $34 is now considered a fair range. Some traders may say they can shade this minimum figure a trifle, but if there is any shading, it is solely because of certain specific conditions as applied to selected customers, the same as might be applicable to these customers at any time. Some of the local mills and foundries report good orders booked for the coming month. A moderate tonnage is on the way but no arrivals are looked for before the latter part of next month. Advices from Los Angeles continue favorable for an enlarged consuming power in that section of the State. Prices there are approximately $1 per ton lower than here.

**Coke.**—Several recent sales of coke indicate that the market is assuming a better position and coupled with the fact that more tonnage is on the way now than for the last few months, there is prospect for an enlarged business within the next 60 days. Foreign grades are now quoted around $20 to $21 per ton, a trifle lower than a month ago. Domestic remains about the same, the selling figure here being based on the delivery price at Eastern points of production.

**Finished Steel and Iron.**—The market is devoid of feature with prices on all commodities practically the same as two weeks ago. The only variation worthy of note is a strengthening element noted on some specialties. Structural steel is in steady demand at steady figures and steel rods and bars for reinforcement purposes are moving more freely than usual with prices on small lots possibly a shade higher. Wire and nails are also in good demand with some houses reporting extensive sales.

**Old Material.**—Sales continue small and business remains very dull. The liberal buying of the late summer doubtless supplied consumers with sufficient to carry them over the first of the year, judging by the scarcity of buying orders now. Prices are the same as before quoted at $13.50 to $14 per ton, although some buyers claim they can purchase the best grades at slightly below the minimum figure. Reports from Los Angeles indicate that business there is active but consumers have an abundance of material on hand and new orders are less numerous than two weeks ago.

# British Iron and Steel Market

## Holidays Make All Markets Quiet—Plate and Sheet Makers Well Placed with Full Order Books

*(By Cable)*

LONDON, ENGLAND, Dec. 31.

All iron and steel markets are quiet owing to the holidays. **There will be no Middlesbrough meeting** on Tuesday. Scotch works are closing for a week or ten days.

Prices are firm, with steel showing an upward tendency well maintained. Plate makers, in particular, are well placed.

There is some fair Continental inquiry, but the high prices are causing hesitation on the part of consumers to place orders.

Foreign ore is quiet. Bilbao Rubio is quoted at 24½s. ($5.32) c.i.f. sellers.

Continental markets are quiet owing to the holidays on this side of the Channel, but the works apparently are in want of orders and prices are tending downward.

Tin plate is firm and quiet; but indications point to renewed activity. Prompt and forward positions have sold up to 24¼s. ($5.26) basis IC, f.o.b.

Galvanized steel sheets are quiet.

Black sheets are quiet but prices are firm, the works having their order books well filled for two to three months ahead.

We quote per gross ton, except where otherwise stated, f.o.b. makers' works, with American equivalent figured at $4.34 per £1, as follows:

| | | | | |
|---|---|---|---|---|
| Durham coke, delivered | £1 18½s. | to £1 19s. | $8.34 | to $8.46 |
| Bilbao Rubio ore† | 1 4 | | 5.21 | |
| Cleveland No. 1 foundry | 5 6½ | | 23.11 | |
| Cleveland No. 3 foundry | 5 0 | | 21.70 | |
| Cleveland No. 4 foundry | £4 19s. | | $21.48 | |
| Cleveland No. 4 forge | 4 18 | | 21.27 | |
| Cleveland basic | 5 0 | | 21.70 | |
| East Coast mixed | 5 2½ | to £5 3½s. | 22.24 | to $22.46 |
| East Coast hematite | 4 19 | to 5 0 | 21.48 | to 21.70 |
| Ferromanganese | 17 0 | | 73.78 | |
| Ferromanganese* | 17 0 | | 73.78 | |
| Rails, 60 lb. and up | 8 15 | to 9 15 | 37.97 | to 42.31 |
| Billets | 8 5 | to 8 15 | 35.80 | to 37.97 |
| Sheet and tin plate bars, Welsh | 8 18¾ | | 38.79 | |
| Tin plates, base box | 1 3¾ | to 1 4¼ | 5.15 | to 5.26 |
| | | | C. per Lb. | |
| Ship plates | 9 15 | to 10 5 | 1.89 | to 1.99 |
| Boiler plates | 13 0 | to 13 10 | 2.52 | to 2.62 |
| Tees | 10 0 | to 10 10 | 1.94 | to 2.03 |
| Channels | 9 5 | to 9 15 | 1.79 | to 1.89 |
| Beams | 9 0 | to 9 10 | 1.74 | to 1.84 |
| Round bars, ¾ to 3 in. | 10 10 | to 11 0 | 2.03 | to 2.13 |
| Galvanized sheets, 24 g. | 18 10 | to 18 15 | 3.58 | to 3.63 |
| Black sheets, 24 gage | 14 0 | | 2.71 | |
| Black sheets, Japanese specifications | 15 5 | | 2.95 | |
| Steel hoops | 12 10 | & 12 15* | 2.42 | & 2.47* |
| Cold rolled steel strip, 20 gage | 17 12½ | | 3.42 | |
| Cotton ties, Indian specifications | 15 0 | | 2.91 | |

*Export price. †Ex-ship, Tees, nominal.

### Continental Prices, All F. O. B. Channel Ports

*(Nominal)*

| | | | | |
|---|---|---|---|---|
| Foundry pig iron: | | | | |
| Belgium | £4 13½s. | to £4 15s. | $20.29 | to $20.61 |
| France | 4 13½ | to 4 15 | 20.29 | to 20.61 |
| Luxemburg | 4 13½ | to 4 15 | 20.29 | to 20.61 |
| Billets (nominal): | | | | |
| Belgium | 6 2½ | to 6 7½ | 26.58 | to 27.67 |
| France | 6 2½ | to 6 7½ | 26.58 | to 27.67 |
| | | | C. per Lb. | |
| Merchant bars: | | | | |
| Belgium | 7 2½ | to 7 10 | 1.38 | to 1.45 |
| Luxemburg | 7 2½ | to 7 10 | 1.38 | to 1.45 |
| France | 7 2½ | to 7 10 | 1.38 | to 1.45 |
| Joists (beams): | | | | |
| Belgium | 6 15 | to 7 2½ | 1.31 | to 1.38 |
| Luxemburg | 6 15 | to 7 2½ | 1.31 | to 1.38 |
| France | 6 15 | to 7 2½ | 1.31 | to 1.38 |
| Angles: | | | | |
| Belgium | 8 0 | to 8 5 | 1.55 | to 1.60 |
| ⅛-in. plates: | | | | |
| Belgium | 7 17½ | to 8 2½ | 1.53 | to 1.57 |
| Germany | 7 17½ | to 8 2½ | 1.53 | to 1.57 |
| 3/16-in. plates: | | | | |
| Luxemburg | 7 17½ | to 8 2½ | 1.53 | to 1.57 |
| Belgium | 7 17½ | to 8 2½ | 1.53 | to 1.57 |

## FABRICATED STEEL BUSINESS

### Awards of the Week, Including 18,000-Ton Building in New York, Total About 36,000 Tons

Despite the year-end holidays the structural steel market continued active, lettings for the week, as reported to THE IRON AGE, totaling about 36,000 tons, including the New York Telephone Co. building, which requires 18,000 tons. New work for the week totaled about 15,000 tons, most of which is in New York.

New York Telephone Co., building on West Street, New York, 18,000 tons, to Post & McCord; steel to be fabricated by American Bridge Co.

New York City, Pier No. 84, North River, 3000 tons, to American Bridge Co.

American Locomotive Co., shop at Schenectady, N. Y., 900 tons, to McClintic-Marshall Co.

Loft building, West Thirty-fifth Street, New York, 1300 tons, to Hedden Iron Construction Co.

Loft building, West Thirtieth Street, New York, 1800 tons, to Hedden Iron Construction Co.

Loft building, West Thirty-sixth Street, New York, 1700 tons, to George A. Just Co.

Apartment building, West Seventy-fourth Street, New York, 600 tons, to Paterson Bridge Co.

Apartment building, East Thirty-seventh Street, New York, 300 tons, to Paterson Bridge Co.

Apartment building, East Fiftieth Street, New York, 600 tons, to Hedden Iron Construction Co.

Catholic school, Brooklyn, 160 tons, to Communipaw Steel Co.

Ford Motor Co., assembly plant, St. Paul, Minn., 6000 tons, divided between Minneapolis Steel & Machinery Co. and St. Paul Foundry Co.

Dock shed, Los Angeles, 250 tons, to Minneapolis Steel & Machinery Co.

High School building, Sioux City, Iowa, 119 tons, to the Paxton-Vierling Co.

Bethany Girls' Home, Chicago, 107 tons, to American Bridge Co.

Bridge for Woodbury County, Iowa, 183 tons, to Des Moines Steel Co.

Courthouse, Sedalia, Mo., 106 tons, to Des Moines Steel Co.

Bridge, West Twenty-fifth Street, Cleveland, 250 tons, to McClintic-Marshall Co.

Courthouse, Vermillion County, Ind., 150 tons, to Central States Bridge Co.

State of West Virginia, Charleston, first unit of Capitol building, 650 tons, general contract to G. A. Fuller Co.

Pennsylvania Railroad bridge work, Rochester and New Brighton, Pa., 300 tons, to American Bridge Co.

National Biscuit Co., Cleveland, warehouse, 200 tons, to the American Bridge Co.

### Structural Projects Pending

Inquiries for fabricated steel work include the following:

Harriman Bank building, Fifth Avenue and Forty-fourth Street, New York, 4000 tons.

Public Schools Nos. 80, 109 and 201, New York, about 1200 tons each, total 3600 tons.

Magoba loft building, 46 West Twenty-ninth Street, New York, 700 tons.

Levy Brothers loft building, Eighth Avenue and Thirty-eighth Street, New York, 2700 tons.

Rhodes apartment building, 51-55 East Seventy-second Street, New York, 400 tons.

Power station, Charlotte, N. C., 100 tons.

Chicago, Burlington & Quincy, 7 deck plate girder spans and 3 viaduct towers, 250 tons.

Libbey-Owens Sheet Glass Co., Toledo, 2300 tons, bids taken.

Mead Morrison Mfg. Co., Chicago, 12-ton ore bridge to be erected at Tonawanda, N. Y., 450 tons.

Great Northern Railroad, 4 girder spans, 158 tons.

Illinois Central, 3 80-ft. and 2 40-ft. deck plate girder spans and repairs to bridge No. 18, 242 tons.

Filtration plant buildings, Cleveland, 750 tons, general contract placed with Hunkin-Conkey Construction Co.

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The Gas Products Association will hold its tenth mid-winter convention and dinner at the Blackstone, Chicago, on Jan. 17, 18 and 19. C. T. Price, 140 South Dearborn Street, Chicago, is secretary and treasurer.

## RAILROAD EQUIPMENT BUYING

### Southern Pacific Awards Orders for 5480 Cars and Will Build 1075 in Own Shops

Orders of the Southern Pacific Railroad for a total of 5480 freight cars comprised the only important lettings of railroad equipment the past week. This road will also build 1075 freight cars in its own shops. Close to 75,000 tons of steel will be required for these cars.

Surplus freight cars in good repair and immediately available for service totaled 216,936 on Dec. 14, an increase of 19,808 since Dec. 7, due to the seasonal decline in the demand for transportation facilities, according to the Car Service Division, American Railway Association. Car shortage has entirely disappeared.

The Northern Pacific is inquiring for 200 75-ton ore cars.

The Western Pacific is inquiring for 200 70-ton ore cars.

The Southern Pacific has placed the following orders for cars: 2975 box cars to the Standard Steel Car Co.; 450 flat, 250 stock and 500 gondola cars to the Ralston Steel Car Co.; 205 tank and 600 drop bottom gondola cars to the General American Car Co., and 500 automobile cars to the Pullman Co. The Southern Pacific will build in its own shops 500 flat, 75 caboose and 500 logging cars.

The New York Central has entered the market for 500 box cars.

The Fruit Growers Express will build 1000 refrigerator cars in its own shops.

The Southern Pacific is inquiring for 15 dining, 23 baggage, 6 combination baggage and horse, and 6 combination buffet and baggage cars.

The New York Central has placed 500 stock car bodies with the Ryan Car Co., 400 stock car bodies with the Standard Tank Car Co., 500 flat car bodies with the Youngstown Steel Car Co., and 500 flat car bodies with the Pennsylvania Tank Car Co.

The Chesapeake & Ohio is inquiring for repairs on 1500 gondola cars.

## GERMAN IRON AND STEEL MARKET

### Prices Falling to International Level—Coal to Be Lower—October Machinery Exports Above September

*(By Radiogram)*

BERLIN, GERMANY, Dec. 31.—The iron and steel market is weakening, except for thick sheets.

Ruhr furnaces and rolling mills are slowly resuming work, but still 29 per cent of the steel workers are unemployed.

Prices are falling. Coal is to be reduced 10 per cent from Jan. 2. Prices which were fixed by the Steel Syndicate before its dissolution have been reduced, on the average, 20 per cent.

Steel bars are now quoted at 145 gold marks per metric ton (1.57c. per lb.) and foundry pig iron at 116 gold marks ($28.05 per gross ton). Prices are again at about the international level, but below the Czecho-Slovakian and Polish figures.

Machinery exports for October amounted to 27,795 tons against 20,692 tons in September and a monthly average of 39,914 throughout 1922.

### Southern Railway System to Extend Birmingham Shops

Dwight P. Robinson & Co., Inc., has been authorized to design and construct extensive additions to the shops of the Southern Railway Co. at Birmingham, Ala. The work includes locomotive repair shops, boiler and smith shop, car repair sheds, mill shop, power plant and other buildings.

## NON-FERROUS METALS

### The Week's Prices

Cents per Pound for Early Delivery

| | Copper, New York | | Straits Tin | Lead | | Zinc | |
|---|---|---|---|---|---|---|---|
| Dec. | Lake | Electrolytic* | New York | New York | St. Louis | New York | St. Louis |
| 26...... | 13.25 | 12.75 | 47.37½ | 8.00 | 7.75 | 6.62½ | 6.27½ |
| 27...... | 13.25 | 12.75 | 47.30 | 8.00 | 7.75 | 6.62½ | 6.27½ |
| 28...... | 13.25 | 12.75 | 46.62½ | 8.00 | 7.75 | 6.62½ | 6.27½ |
| 29...... | 13.25 | 12.75 | .... | 8.00 | 7.75 | 6.62½ | 6.27½ |
| 31...... | 13.25 | 12.75 | 46.75 | 8.00 | 7.75 | 6.62½ | 6.27½ |

*Refinery quotations; delivered price ¼c. higher.

### New York

NEW YORK, Dec. 31.

All the markets are quiet or only moderately active because of the holidays. The strongest is the lead market. News features or price changes have been few.

**Copper.**—At the close of the year the copper market was slightly weaker, producers' prices generally being 13c., delivered, while second hands have made offers as low as 12.87½c., delivered. In view of the very small volume of business that has been transacted during December the view of copper producers is that prices have held surprisingly well. The holiday week has been very quiet. Copper stocks in consumers' hands are believed to be low and an improvement in demand is looked for early in the new year.

**Copper Averages.**—The average price of Lake copper for the month of December, based on daily quotations in THE IRON AGE, was 13.25c. The average price of electrolytic copper was 12.85c. refinery, or 13.10c. delivered.

**Tin.**—Generally the market has been quiet, due to the holiday season. On Dec. 26 the market was stagnant, but on the following day about 100 to 150 tons of Straits tin was sold, spot bringing 47.37½c. and guaranteed January delivery, 47.25c., with futures neglected. A little business was done on Dec. 28, with futures selling at 46.35c. down to 46.10c. On Monday, Dec. 24, about 100 tons changed hands and during the past week about 100 tons was sold on the New York Metal Exchange. Late in the day on Dec. 28 considerable business developed, the total amounting to about 300 tons, with consumers and dealers the buyers. Shipments from the Straits for December had been generally estimated at 7000 tons and it turns out that the actual total was 6980 tons, of which 5270 tons was shipped to the United States, 805 tons to Continental Europe and 905 tons to Great Britain. Deliveries into consumption for December were 4810 tons, with 1652 tons in stock and landing on Dec. 31. Reports as to the amount of deliveries into American consumption are not regarded as favorable by the trade. Spot Straits tin today was quoted at 46.75c., New York, with the market quiet. London prices were about £1 per ton lower than a week ago at £233 15s. for spot standard, £235 5s. for future standard and £325 15s. for spot Straits. Arrivals thus far this month have been 5395 tons, with 3831 tons reported afloat.

**Lead.**—The feature of the week was another advance in the price of the leading interest on Dec. 29 from 7.40c. to 7.50c., New York. The market has been a quiet one with prices firm and no business of consequence transacted. Quotations of 7.75c., St. Louis, and 8c., New York, in the outside market are regarded as largely nominal. A good inquiry appeared today, but it is believed that much of it is with the object of obtaining a market price for inventory purposes.

**Zinc.**—Although some producers are holding for 6.30c., St. Louis, or 6.65c., New York, zinc is to be had at 6.27½c., St. Louis, or 6.62½c. New York, which is slightly above the quotations of a week ago. Demand is of moderate proportions. Producers, viewing present prices as unsatisfactory, are little inclined to sell for more than spot delivery, and consumers see no reason to anticipate their requirements for more than a week or two ahead; hence the market is drifting but gaining slightly in strength.

**Nickel.**—Quotations of shot and ingot nickel are unchanged at 29c. to 32c. per lb., with electrolytic nickel held at 32c. by the leading producers. Both shot and ingot nickel in the outside market are quoted at 29c. to 32c. per lb.

**Antimony.**—The market is a little easier and wholesale lots of Chinese metal are quoted at 9.75c. to 10c., New York, duty paid, for early delivery.

**Aluminum.**—Virgin metal, 98 to 99 per cent pure, is quoted by importers at 26c. to 26.50c., duty paid, with only a few importers able to do business. The leading American producer does not make public its quotations.

**Old Metals.**—Business has a holiday aspect. Outside of a little foreign business there is nothing being done. Dealers' selling prices are as follows:

| | Cents Per Lb. |
|---|---|
| Copper, heavy and crucible | 12.75 |
| Copper, heavy and wire | 11.75 |
| Copper, light and bottoms | 10.00 |
| Heavy machine composition | 10.75 |
| Brass, heavy | 8.00 |
| Brass, light | 6.25 |
| No. 1 red brass or composition turnings | 9.00 |
| No. 1 yellow rod brass turnings | 7.00 |
| Lead, heavy | 7.00 |
| Lead, tea | 5.75 |
| Zinc | 5.00 |
| Cast aluminum | 18.00 |
| Sheet aluminum | 18.00 |

### Chicago

CHICAGO, Jan. 1.—Outside of moderate buying of tin and lead last week, which has since subsided, the market has been quiet. Tin, after advancing a few points last week, has declined to the same figure at which it was quoted one week ago. Lead and zinc have advanced slightly. Old metal prices remain unchanged. We quote in carload lots: Lake copper, 13.50c.; tin, 48.50c.; lead, 7.75c.; spelter, 6.30c.; antimony, 11c., in less than carload lots. On old metals we quote copper copper wire crucible shapes and copper clips, 10.50c.; copper bottoms, 9.50c.; red brass, 8.75c.; yellow brass, 6.75c.; lead pipe, 6.50c.; zinc, 4.25c.; pewter, No. 1, 27c; tin foil, 33c; block tin, 38c.; all buying prices for less than carload lots.

## Detroit Scrap Market

DETROIT, Dec. 31.—There has been considerable activity in the Detroit market on old material, as the mills and furnaces have been doing some buying for first quarter as well as local dealers. The recent letting by one of the largest producers of approximately 3500 tons miscellaneous scrap reflected the firm tone of the market and this strengthening note is shown on daily sales. Advances were registered on most grades of from 50c. to $2.00 per ton.

The following prices are quoted on a gross ton basis f.o.b. cars producers' yards, excepting stove plate, No. 1 machinery cast and automobile cast, which are quoted on a net ton basis:

| | |
|---|---|
| Heavy melting steel | $15.00 to $16.00 |
| Shoveling steel | 15.00 to 16.00 |
| Borings | 11.50 to 12.50 |
| Short turnings | 11.50 to 12.00 |
| Long turnings | 10.50 to 11.50 |
| No. 1 machinery cast | 18.00 to 18.50 |
| Automobile cast | 24.00 to 25.00 |
| Hydraulic compressed | 13.50 to 14.25 |
| Stove plate | 16.00 to 17.50 |
| No. 1 busheling | 11.00 to 11.50 |
| Sheet clippings | 10.00 to 10.50 |
| Flashings | 12.50 to 13.50 |

# Prices Finished Iron and Steel f.o.b. Pittsburgh

**Carload Lots**

## Plates

Sheared, tank quality, base, per lb....................2.50c.

## Structural Materials

Beams, channels, etc., base, per lb....................2.50c.
Sheet piling ....................................2.65c.

## Iron and Steel Bars

Soft steel bars, base, per lb.........................2.40c.
Soft steel bars for cold finishing..........$3 per ton over base
Reinforcing steel bars, base.........................2.40c.
Refined iron bars, base, per lb................3.10c. to 3.15c.
Double refined iron bars, base, per lb..................4.75c.
Stay bolt iron bars, base, per lb................7.75c. to 8c.

## Hot-Rolled Flats

Hoops, base, per lb.....................................3c.
Bands, base, per lb.....................................3c.
Strips, base, per lb....................................3c.

## Cold-Finished Steel

Bars and shafting, base, per lb..........................3c.
Bars, S. A. E. Series, No. 2100.......................4.75c.
Bars, S. A. E. Series, No. 2300..............6.25c. to 6.50c.
Bars, S. A. E. Series, No. 3100..............5.25c. to 5.50c.
Strips, base, per lb..................................5.00c.

## Wire Products

Nails, base, per keg..................................$3.00
Galvanized nails, 1 in. and over..............$2.25 over base
Galvanized nails, less than 1 in.............. 2.50 over base
Bright plain wire, base, No. 9 gage, per 100 lb........$2.75
Annealed fence wire, base, per 100 lb.................. 2.90
Spring wire, base, per 100 lb.......................... 3.70
Galvanized wire, No. 9, base, per 100 lb............... 3.35
Galvanized barbed, base, per 100 lb.................... 3.80
Galvanized staples, base, per keg...................... 3.80
Painted barbed wire, base, per 100 lb.................. 3.45
Polished staples, base, per keg........................ 3.45
Cement coated nails, base, per count keg............... 2.70
Bale ties, carloads to jobbers......75 and 2½ per cent off list
Woven fence, carloads (to jobbers)......67½ per cent off list
Woven fence, carloads (to retailers).......65 per cent off list

## Bolts and Nuts

Machine bolts, small, rolled threads,
60, 10 and 10 per cent off list
Machine bolts, all sizes, cut threads..60 and 10 per cent off list
Carriage bolts, ⅜ x 6 in.:
Smaller and shorter, rolled threads.60 and 10 per cent off list
Carriage bolts, cut threads, all sizes.......60 per cent off list
Lag bolts .........................65 and 10 per cent off list
Plow bolts, Nos. 1, 2 and 3 heads...50 and 10 per cent off list
Other style heads.........................20 per cent extra
Machine bolts, c.p.c. and t. nuts, ⅜ x 4 in.,
50 and 10 per cent off list
Larger and longer sizes............50 and 10 per cent off list
Hot pressed square or hex. nuts, blank.........4.50c. off list
Hot pressed nuts, tapped.......................4.50c. off list
C.p.c. and t. square or hex. nuts, blank..........4.25c. off list
C.p.c. and t. square or hex. nuts, tapped........4.25c. off list
Semi-finished hex. nuts:
9/16 in. and smaller, U. S. S..........80 and 5 per cent off list
⅝ in. and larger, U. S. S............75 and 5 per cent off list
Small sizes, S. A. E...........80, 10 and 5 per cent off list
S. A. E., ⅝ in. and larger......75, 10 and 5 per cent off list
Stove bolts in packages..........75, 10 and 5 per cent off list
Stove bolts in bulk...........75, 10, 5 and 2½ per cent off list
Tire bolts ........................60 and 10 per cent off list
Bolt ends with hot pressed nuts......60 and 5 per cent off list
Turnbuckles, with ends, ½ in. and smaller,
50 to 55 and 5 per cent off list
Turnbuckles, without ends, ½ in. and smaller,
65 and 5 to 70 and 10 per cent off list
Washers ............................5c. to 5.25c. off list

## Semi-Finished Castellated and Slotted Nuts

(To jobbers and consumers in large quantities f.o.b. Pittsburgh.)

| | Per 1000 S. A. E. | Per 1000 U. S. S. | | Per 1000 S. A. E. | Per 1000 U. S. S. |
|---|---|---|---|---|---|
| ¼-in. ........ | $4.80 | $4.80 | 9/16-in. ........ | $15.00 | $15.00 |
| 5/16-in. ........ | 5.50 | 6.00 | ⅝-in. ........ | 19.50 | 20.00 |
| ⅜-in. ........ | 6.50 | 7.00 | ¾-in. ........ | 28.50 | 28.50 |
| 7/16-in. ........ | 9.00 | 9.50 | ⅞-in. ........ | 37.00 | 37.50 |
| ½-in. ........ | 11.00 | 11.50 | 1-in. ........ | 58.50 | 60.50 |

Larger sizes—Prices on application.

## Cap and Set Screws

Milled square and hex. head cap screws.....70 per cent off list
Milled set screws..........................70 per cent off list
Upset cap screws...................75 and 10 per cent off list
Upset set screws...................75 and 10 per cent off list
Milled studs ......................50 and 10 per cent off list

## Rivets

Large structural and ship rivets, base, per 100 lb......$2.90
Small rivets ............................65, 10 and 5 off list

## Track Equipment

Spikes, 9/16 in. and larger, base, per 100 lb......$3.05 to $3.15
Spikes, ½ in., 7/16 in. and ⅜ in., per 100 lb...... 3.25 to 3.50
Spikes, 5/16 in................................ 3.25 to 3.50
Spikes, boat and barge, base, per 100 lb........ 3.25 to 3.50
Track bolts, ¾ in and larger, base, per 100 lb.. 4.00 to 4.25
Track bolts, ½ in. and ⅝ in., base, per 100 lb.. 5.00 to 5.50
Tie plates, per 100 lb......................... 2.55 to 2.60
Angle bars, base, per 100 lb................... 2.75

## Welded Pipe

*Butt Weld*

| Steel Inches | Steel Black | Steel Galv. | Iron Inches | Iron Black | Iron Galv. |
|---|---|---|---|---|---|
| ⅛ .......... | 45 | 19½ | ¼ to ⅜..... | +11 | +39 |
| ¼ to ⅜..... | 51 | 25½ | ½ .......... | 22 | 2 |
| ½ .......... | 56 | 42½ | ¾ .......... | 28 | 11 |
| ¾ .......... | 60 | 48½ | 1 to 1½..... | 30 | 13 |
| 1 to 3....... | 62 | 50½ | | | |

*Lap Weld*

| Steel Inches | Steel Black | Steel Galv. | Iron Inches | Iron Black | Iron Galv. |
|---|---|---|---|---|---|
| 2 .......... | 55 | 43½ | 2 .......... | 23 | 7 |
| 2½ to 6..... | 59 | 47½ | 2½ .......... | 26 | 11 |
| 7 and 8...... | 56 | 43½ | 3 to 6....... | 28 | 13 |
| 9 and 10..... | 54 | 41½ | 7 to 12...... | 26 | 11 |
| 11 and 12.... | 53 | 40½ | | | |

*Butt Weld, extra strong, plain ends*

| Steel Inches | Steel Black | Steel Galv. | Iron Inches | Iron Black | Iron Galv. |
|---|---|---|---|---|---|
| ⅛ .......... | 41 | 24½ | 2 to 3....... | 61 | 50½ |
| ¼ to ⅜..... | 47 | 30½ | ¼ to ⅜...... | +19 | +54 |
| ½ .......... | 53 | 42½ | ½ .......... | 21 | 7 |
| ¾ .......... | 58 | 47½ | ¾ .......... | 28 | 12 |
| 1 to 1½..... | 60 | 49½ | 1 to 1½..... | 30 | 14 |

*Lap Weld, extra strong, plain ends*

| Steel Inches | Steel Black | Steel Galv. | Iron Inches | Iron Black | Iron Galv. |
|---|---|---|---|---|---|
| 2 .......... | 53 | 42 | 2 .......... | 23 | 9 |
| 2½ to 4..... | 57 | 46½ | 2½ to 4..... | 29 | 15 |
| 4½ to 6..... | 56 | 45½ | 4½ to 6..... | 28 | 14 |
| 7 to 8....... | 52 | 39½ | 7 to 8....... | 21 | 7 |
| 9 and 10..... | 45 | 32½ | 9 to 12...... | 16 | 2 |
| 11 and 12.... | 44 | 31½ | | | |

To the large jobbing trade the above discounts are increased by one point, with supplementary discounts of 5 per cent on black and 1½ points, with a supplementary discount of 5 per cent on galvanized.

## Boiler Tubes

| *Lap Welded Steel* | | *Charcoal Iron* | |
|---|---|---|---|
| 2 to 2¼ in........... | 27 | 1½ in. ............. | +18 |
| 2½ to 2¾ in.......... | 37 | 1¾ to 1⅞ in.......... | + 8 |
| 3 in. ................ | 40 | 2 to 2¼ in.......... | — 2 |
| 3¼ to 3¾ in.......... | 42½ | 2½ to 3 in.......... | — 7 |
| 4 to 13 in........... | 46 | 3¼ to 4½ in......... | — 9 |

Less carload lots 4 points less.

*Standard Commercial Seamless Boiler Tubes*

*Cold Drawn*

| | | | |
|---|---|---|---|
| 1 in. ................ | 55 | 3 and 3¼ in......... | 36 |
| 1¼ and 1½ in...... | 47 | 3½ and 3¾ in........ | 37 |
| 1¾ in. ............... | 31 | 4 in. ................ | 41 |
| 2 and 2¼ in........ | 22 | 4½ in. and 5 in...... | 33 |
| 2½ and 2¾ in........ | 32 | | |

*Hot Rolled*

| | | | |
|---|---|---|---|
| 3 and 3¼ in........ | 38 | 4 in. ................ | 43 |
| 3½ in. and 3¾ in.... | 39 | | |

Less carloads, 4 points less. Add $8 per net ton for more than four gages heavier than standard. No extras for lengths up to and including 24 ft. Sizes smaller than 1 in. and lighter than standard gage to be sold at mechanical tube list and discount. Intermediate sizes and gages not listed take price of net larger outside diameter and heavier gage.

*Seamless Mechanical Tubing*

Carbon under 0.30, base.....................84 per cent off list
Carbon 0.30 to 0.40, base...................82 per cent off list

Plus usual differentials and extras for cutting. Warehouse discounts range higher.

*Seamless Locomotive and Superheater Tubes*

| | Cents per Ft. | | Cents per Ft. |
|---|---|---|---|
| 2-in. O.D. 12 gage.... | 15 | 2¼-in. O.D. 10 gage.. | 20 |
| 2-in. O.D. 11 gage.... | 16 | 3-in. O.D. 7 gage..... | 35 |
| 2-in. O.D. 10 gage.... | 17 | 1½-in. O.D. 9 gage... | 15 |
| 2¼ in. O.D. 12 gage.. | 17 | 5⅜-in. O.D. 9 gage... | 55 |
| 2¼-in. O.D. 11 gage.. | 18 | 5½-in. O.D. 9 gage... | 57 |

## Tin Plate

Standard cokes, per base box..........................$5.50

## Terne Plate

(Per Package, 20 x 28 in.)

| | | | |
|---|---|---|---|
| 8-lb. coating, 100 lb. base ............ | $11.00 | 20-lb. coating I. C.... | $14.90 |
| 8-lb. coating I. C.... | 11.30 | 25-lb. coating I. C.... | 16.20 |
| 12-lb. coating I. C.... | 12.70 | 30-lb. coating I. C.... | 17.35 |
| 15-lb. coating I. C.... | 13.95 | 35-lb. coating I. C.... | 18.35 |
| | | 40-lb. coating I. C.... | 19.35 |

## Sheets

*Blue Annealed*

Nos. 9 and 10 (base), per lb..............................3c.

*Box Annealed, One Pass Cold Rolled*

No. 28 (base), per lb......................3.75c. to 3.85c.

*Automobile Sheets*

Regular auto body sheets, base (22 gage), per lb......5.35c.

*Galvanized*

No. 28 (base), per lb........................4.90c. to 5c.

*Long Ternes*

No. 28 gage (base), 8-lb. coating, per lb.............5.30c.

*Tin-Mill Black Plate*

No. 28 (base), per lb.................................3.85c.

# Prices of Raw Materials, Semi-Finished and Finished Products

## Ores

*Lake Superior Ores, Delivered Lower Lake Ports*

| | |
|---|---|
| Old range Bessemer, 55 per cent iron | $6.45 |
| Old range non-Bessemer, 51½ per cent iron | 5.70 |
| Mesabi Bessemer, 55 per cent iron | 6.20 |
| Mesabi non-Bessemer, 51½ per cent iron | 5.55 |

*Foreign Ore, per Unit, c.i.f. Philadelphia or Baltimore*

| | |
|---|---|
| Iron ore, low phos., copper free, 55 to 58 per cent iron in dry Spanish or Algerian | 11.00c. |
| Iron ore, Swedish, average 66 per cent iron | 9.50c. |
| Manganse ore, washed, 51 per cent manganese, from the Caucasus, nominal | 41c. |
| Manganese ore, ordinary, 48 per cent manganese, from the Caucasus | 38c. |
| Manganese ore, Brazilian or Indian, nominal | 42c. |
| Tungsten ore, per unit, in 60 per cent concentrates | $8.25 to $10.00 |
| Chrome ore, basic, 48 per cent $Cr_2O_3$, crude, per ton, c.i.f. Atlantic seaboard | 18.00 to 28.00 |
| Molybdenum ore, 85 per cent concentrates, per lb. of $MoS_2$, New York | 75c. to 85c. |

## Ferroalloys

| | |
|---|---|
| Ferromanganese, domestic, 80 per cent, furnace, or seaboard, per ton | $109.00 to $110.00 |
| Ferromanganese, British, 80 per cent, f.o.b. Atlantic port, duty paid | 110.00 |
| Ferrosilicon, 50 per cent, delivered | 75.00 |
| Ferrotungsten, per lb. contained metal | 85c. to 90c. |
| Ferrochromium, 4 to 6 per cent carbon, 60 to 70 per cent Cr. per lb. contained Cr. delivered | 11c. to 12c. |
| Ferrochromium, 6 to 7 per cent carbon, 60 to 70 per cent Cr., per lb | 10c. to 11c. |
| Ferrovanadium, per lb. contained vanadium | $3.50 to $4.00 |
| Ferrocarbontitanium, 15 to 18 per cent, per net ton | 200.00 |

## Spiegeleisen, Bessemer Ferrosilicon and Silvery Iron

(Per gross ton furnace unless otherwise stated)

Spiegeleisen, domestic, 19 to 21 per cent....$38.00 to $39.00
Spiegeleisen, domestic, 16 to 19 per cent.... 37.00 to 38.00
Ferrosilicon, Bessemer, 10 per cent, $41.50; 11 per cent, $44; 12 per cent, $46.50.
Silvery iron, 6 per cent, $30.00; 7 per cent, $31.00; 8 per cent, $32.50; 9 per cent, $34.50; 10 per cent, $36.50; 11 per cent, $39.00; 12 per cent, $41.50.

## Fluxes and Refractories

Fluorspar, 80 per cent and over calcium fluoride, not over 5 per cent silica, per net ton f.o.b. Illinois and Kentucky mines .......... $22.00
Fluorspar, 85 per cent and over calcium fluoride, not over 5 per cent silica, per net ton f.o.b. Illinois and Kentucky mines .......... 23.50

Per 1000 f.o.b. works:

| Fire Clay: | High Duty | Moderate Duty |
|---|---|---|
| Pennsylvania | $42.00 to $45.00 | $37.00 to $42.00 |
| Maryland | 47.00 | 42.00 |
| Ohio | 42.00 to 43.00 | 37.00 to 39.00 |
| Kentucky | 42.00 to 43.00 | 37.00 to 39.00 |
| Illinois | —— | 37.00 to 42.00 |
| Missouri | 42.00 to 45.00 | 35.00 to 40.00 |
| Ground fire clay, per net ton | | 6.00 to 7.00 |

| | |
|---|---|
| **Silica Brick:** | |
| Pennsylvania | 42.00 |
| Chicago | 49.00 |
| Birmingham | 50.00 |
| Ground silica clay, per net ton | 8.00 |
| **Magnesite Brick:** | |
| Standard size, per net ton (f.o.b. Baltimore and Chester, Pa.) | 65.00 |
| Grain magnesite, per net ton (f.o.b. Baltimore and Chester, Pa.) | 40.00 |
| **Chrome Brick:** | |
| Standard size, per net ton | 48.00 |

## Semi-Finished Steel, F.O.B. Pittsburgh or Youngstown, per gross ton

| | |
|---|---|
| Rolling billets, 4-in. and over | $40.00 |
| Rolling billets, 2-in. and under | 40.00 |
| Forging billets, ordinary carbons | 45.00 |
| Sheet bars, Bessemer | 42.50 |
| Sheet bars, open-hearth | 42.50 |
| Slabs | 40.00 |
| Wire rods, common soft, base, No. 5 to ⅝-in | 51.00 |
| Wire rods, common soft, coarser than ⅝-in | $2.50 over base |
| Wire rods, screw stock | $5.00 per ton over base |
| Wire rods, carbon 0.20 to 0.40 | 3.00 per ton over base |
| Wire rods, carbon 0.41 to 0.55 | 5.00 per ton over base |
| Wire rods, carbon 0.56 to 0.75 | 7.50 per ton over base |
| Wire rods, carbon over 0.75 | 10.00 per ton over base |
| Wire rods, acid | 15.00 per ton over base |
| Skelp, grooved, per lb | 2.35c. to 2.40c. |
| Skelp, sheared, per lb | 2.35c. to 2.40c. |
| Skelp, universal, per lb | 2.35c. to 2.40c. |

## Finished Iron and Steel, F.O.B. Mill

| | |
|---|---|
| Rails, heavy, per gross ton | $43.00 |
| Rails, light, new steel, base, lb | 2.25c. |
| Rails, light, rerolled, base, per lb | 1.85c. to 2.00c. |
| Spikes, 9/16-in. and larger, base, per 100 lb | $3.00 to $3.15 |
| Spikes, ½-in. and smaller, base, per 100 lb | 3.15 to 3.50 |
| Spikes, boat and barge, base, per 100 lb | 3.25 to 3.50 |
| Track bolts, ⅝-in. and smaller, base, per 100 lb. | 4.00 to 4.25 |
| Track bolts, ¾-in. and larger, base, per 100 lb. | 4.50 to 5.00 |
| Tie plates, per 100 lb. | 2.55 to 2.60 |
| Angle bars, per 100 lb. | 2.75 |
| Bars, common iron, base, per lb., Chicago mill | 2.40c. |
| Bars, common iron, Pittsburgh mill | 2.40c. |
| Bars, rails, steel reinforcing, base, per lb. | 2.15c. to 2.25c. |
| Cold finished steel bars, base, Chicago per lb. | 3c. |
| Ground shafting, base, per lb | 3.40c. |
| Cut nails, base, per keg | $3.15 to $3.25 |

## Alloy Steel

| S.A.E. Series Numbers | | Bars 100 lb. |
|---|---|---|
| 2100* | (½% Nickel, 10 to 20 per cent Carbon) | $3.50 |
| 2300 | (3½% Nickel) | 5.00 to 5.25 |
| 2500 | (5% Nickel) | 7.75 to 8.00 |
| 3100 | (Nickel Chromium) | 4.00 to 4.25 |
| 3200 | (Nickel Chromium) | 5.75 to 6.00 |
| 3300 | (Nickel Chromium) | 8.00 to 8.25 |
| 3400 | (Nickel Chromium) | 7.00 to 7.25 |
| 5100 | (Chromium Steel) | 3.75 |
| 5200* | (Chromium Steel) | 7.50 to 8.00 |
| 6100 | (Chromium Vanadium bars) | 4.75 to 5.00 |
| 6100 | (Chromium Vanadium spring steel) | 4.50 to 4.75 |
| 9250 | (Silico Manganese spring steel) | 3.75 to 4.00 |
| Nickel Chrome Vanadium (0.60 Nickel, 0.50 Chromium, 0.15 Vanadium) | | 5.00 to 5.25 |
| Chromium Molybdenum bars (0.80—1.10 Chromium, 0.25—0.40 Molybdenum) | | 4.50 to 4.75 |
| Chromium Molybdenum bars (0.50—0.70 Chromium, 0.15—0.25 Molybdenum) | | 4.25 to 4.50 |
| Chromium Molybdenum spring steel (1—1.25 Chromium, 0.30—0.50 Molybdenum) | | 4.75 to 5.00 |

Above prices are for hot-rolled alloy steel bars, forging quality, per 100 lb., f.o.b. Pittsburgh. Billets 4 x 4 in. and larger are $10 per gross ton less than net ton price for bars of same analyses. On smaller than 4 x 4-in. billets the net ton bar price applies.

*Not S.A.E. specifications, but numbered by manufacturers to conform to S.A.E. system.

# Freight Rates

All rail freight rates from Pittsburgh on finished iron and steel products, carload lots, 36,000 lb. minimum carload, per 100 lb.:

| | | | | | | | |
|---|---|---|---|---|---|---|---|
| Philadelphia, domestic | $0.32 | Buffalo | $0.265 | St. Louis | $0.43 | *Pacific Coast | $1.15 |
| Philadelphia, export | 0.235 | Cleveland | 0.215 | Kansas City | 0.735 | *Pac. Coast, ship plates | 1.20 |
| Baltimore, domestic | 0.31 | Cleveland, Youngstown Comb. | 0.19 | Kansas City (pipe) | 0.705 | Birmingham | 0.58 |
| Baltimore, export | 0.225 | Detroit | 0.29 | St. Paul | 0.60 | Memphis | 0.56 |
| New York, domestic | 0.34 | Cincinnati | 0.29 | Omaha | 0.735 | Jacksonville, all rail | 0.70 |
| New York, export | 0.255 | Indianapolis | 0.31 | Omaha (pipe) | 0.705 | Jacksonville, rail and water | 0.415 |
| Boston, domestic | 0.365 | Chicago | 0.34 | Denver | 1.26 | New Orleans | 0.67 |
| Boston, export | 0.255 | | | †Denver (pipe) | 1.17 | | |

*Applies minimum carload 80,000 lb. †Minimum loading 46,000 lb.

Rates from Atlantic Coast ports (i.e., New York, Philadelphia and Baltimore) to Pacific Coast ports of call on most steamship lines, via the Panama Canal, are as follows: Pig iron, 35c.; ship plates, 40c.; ingot and muck bars, structural steel, common wire products including cut or wire nails, spikes, and wire hoops, 40c.; sheets and tin plates, 40c.; sheets, No. 12 gage and lighter, 50c.; rods, 40c.; wire rope cables and strands, 45c.; wire fencing, netting and stretcher, 40c.; pipes not over 12 in. in diameter, 55c.; over 12 in. in diameter, 2½c. per in. or fraction thereof additional. All rates per 100 lb. in carload lots, minimum 36,000 lb.

## PERSONAL

Oswald Fowler, of Rogers, Brown & Co., 30 Church Street, New York, was advanced to full membership in the firm on Jan. 1 as one of the New York partners.

H. P. Swan, of the Cadillac Motor Car Co., Detroit, has been elected by the directors of the American Foundrymen's Association as the official representative of the association on the International Committee on Gray Iron Test Bar. This committee was constituted at the international convention of foundrymen held in Paris, Sept. 12-15.

Henry M. Lane, Detroit, arrived in New York Dec. 31 after a four months' stay in Europe. In addition to the contract he has had in hand in the construction of the Citroen foundry at Paris, he has carried on considerable work for a large American foundry interest in France as well as for several French foundry firms.

Horace N. Case, representing the Winter Brothers Co., Wrentham, Mass., manufacturer of taps and dies, and formerly purchasing agent for the Becker Milling Machine Co., has resigned to become associated with Chase, Parker & Co., Boston, iron, steel and supplies.

M. A. Sherritt, one of the founders of the Sherritt & Stoer Co., Philadelphia, dealer in machine tools and railroad equipment, has resigned from the firm and disposed of his interests in it. His plans are not definite.

R. L. Shugg, who has been assistant district manager of sales of the American Rolling Mill Co. at Cincinnati for the past several years, has been transferred to a similar position in Detroit.

Nicholas M. Du Chemin has assumed the duties of general superintendent of the West Lynn, Mass., plant of the General Electric Co., succeeding William J. Lloyd, who died Oct. 28. During the World War Mr. Du Chemin was commissioned lieutenant in the Navy in charge of construction for aviation purposes.

**Anthony Fleck, engineer, formerly specializing in concrete machinery conveying systems, has joined the A. D. Granger Co., 15 Park Row, New York, as sales engineer, specializing in boilers of all classes including Oswego water tube boilers, electric traveling cranes, hoists and complete power plant work.**

**H. A. Hoffer has been appointed Eastern sales manager of the United States Cast Iron Pipe & Foundry Co. and will make headquarters at the Morris Building, Philadelphia. G. T. Overholt was appointed acting New York sales agent of the company with headquarters at 71 Broadway, and Thomas Simons as Kansas City sales agent with headquarters at Interstate Building.**

**Charles M. Power, formerly general sales manager United States Chain & Forging Co., Pittsburgh, has been made general sales manager of the Cleveland Chain & Mfg. Co., with chain plants at Cleveland, Wapakoneta, Ohio, and Seattle, Wash. Mr. Power has been prominent in the chain trade for many years, first as sales manager for the Seneca Chain Co., Kent, Ohio, from 1904 to 1909, and then for seven years in a like capacity with the Standard Chain Co., Pittsburgh. When the latter was taken over in 1916 by the American Chain Co., Bridgeport, Conn., he went with that company as sales manager of the welded chain division. Upon the formation of the United States Chain & Forging Co., Pittsburgh, in 1919 he was appointed general sales manager. He resigned in December, 1921, and retired to his farm at Kent, Ohio.**

**William Hendrie, Hamilton, Ont., has been elected president of the Hamilton Bridge Works Co., Ltd., that city, succeeding his brother, the late Sir John S. Hendrie. W. I. S. Hendrie was elected vice-president, and W. B. Champ, reelected managing director and secretary.**

**Frank Reidinger, formerly foreman of the gear department, has become manager of factory service for the Lloyd Mfg. Co., Menominee, Mich.**

## OBITUARY

Julian B. Huff, president Keystone Coal & Coke Co., Philadelphia, died Dec. 23, in a hospital there. Death was attributed to a cerebral hemorrhage, believed to have been brought about by an old polo injury. Mr. Huff formerly resided in Greensburg, Pa., but for several years had made his home in Philadelphia. He was born in Greensburg 45 years ago and was a graduate of Yale. In addition to being president of the Keystone Coal & Coke Co., he was an officer of the Latrobe-Connellsville Coal Co., Inland Coal Co., Inland Realty Co., Acme Gas Coal Co., and a director of the First National Bank, Greensburg. He was interested in farming and owned the Highland stock farm north of Greensburg. Some years ago he organized the Westmoreland Polo and Hunt Club and for a time was a polo player. He is survived by his wife.

Herbert E. Cushman, treasurer Union Twist Drill Co., New Bedford, Mass., died suddenly at his home on Hawthorne Street, that city, on the afternoon of Dec. 27, aged 61 years. Mr. Cushman was prominent in business, being a director of banks and industrial corporations, as well as president of the Old Dartmouth Historical Society, Sons of the Revolution, ex-president of the Board of Trade and a member of the water board. Two daughters survive.

**Gustave Eiffel, builder of the great tower which rises 984 ft. above the Champ de Mars in Paris, and bears his name, died on Dec. 28, aged 91 years. His achievements include a number of Europe's great viaducts, among which are that of Montlucon and that of Garabit in Cantal. When his countryman, M. Bartholdi, conceived the Statue of Liberty which now adorns New York harbor, M. Eiffel constructed for him the interior framework, supporting the shell of the huge figure.**

**Edward Coe Dilworth, aged 45, died in a Pittsburgh hospital, on Dec. 24. For several years he was connected with the Carnegie Steel Co., the American Bridge Co. and the Pittsburgh-Des Moines Steel Co. During the past two years, he was engaged as a consulting engineer. He was a member of the Engineers' Society of Western Pennsylvania and the American Society of Civil Engineers.**

**Michael J. Owens, Toledo, Ohio, prominent inventor of bottle making machinery, died Dec. 27, aged 64 years. He was vice-president of the Owens Bottle Co., the Libbey-Owens Sheet Glass Co. and affiliated with the Kent-Owens Machine Co.**

**Robert Swinburn Wood, secretary and cost expert of the National Stove Manufacturers Association and connected with the Fuller-Warren Co., Troy, N. Y., died in that city on Dec. 27, aged 67 years.**

**Carl Cushing Backus, general superintendent Kenosha, Wis., plant of the Simmons Co., manufacturer of metal furniture, died in that city, Dec. 28, following an acute attack of appendicitis.**

**With the passing, Oct. 27, of Oscar C. Rixson, president Oscar C. Rixson Co., Chicago, manufacturer of door checks and builders' hardware, the builders' hardware industry lost an active and conspicuous figure. Born in Mariehamn, Finland, May 11, 1863, Mr. Rixson came to the United States in 1882 and followed the profession of architecture until he had accumulated the means to provide for a four years' course in the school of Beaux Arts in France. Upon his return to this country, he resumed work in the architectural field for several years in New York and Chicago. His natural mechanical bent, however, soon led him into the development of mechanical devices for the building industry and eventually caused him to invent and manufacture building hardware specialties.**

## New Capacity in Iron and Steel Works

(*Concluded from page 114*)

ated by the Queen City Foundry Co., Denver, Colo., whose business it will carry on in addition to the production of manganese steel castings at its original plant.

A new company, the Eastern Steel Castings, Newark, N. J., which took over the business last year of the Bayonne Steel Casting Co., Bayonne, N. J., erected a new steel foundry for both open-hearth and electric steel castings. One 8-ton open-hearth furnace was put in operation as well as one Moore electric steel furnace. A description of this plant appeared in THE IRON AGE of Oct. 4, 1923.

## Addition to Electric Steel Furnace Capacity

CONSIDERABLE progress was made in 1923 in the expansion of the electric steel industry, measured by the installation and sale of new furnaces. No attempt is made this year to catalog in the form of a complete review all of the installations of electric furnaces in the country. The industry has grown to such large proportions and the interchange of furnaces by sale and otherwise is such that satisfactory details are no longer possible.

In the following some of the principal sales and changes made during the past year by certain electric furnace interests are recorded:

### Heroult Furnaces

New installations during 1923 of the Heroult furnaces by the American Bridge Co., 71 Broadway, New York, were as follows:

| | | |
|---|---|---|
| | Manganese Castings | |
| Pettibone-Mulliken Co., Chicago | 2 | (3-ton) |
| Lorain Steel Co., Johnstown, Pa. | 2 | (3-ton) |
| | Castings | |
| Damascus Crucible Steel Co., Hammond, Ind. | 1 | (2-ton) |
| Firth-Sterling Steel Co., McKeesport, Pa. | 1 | (3-ton) |
| Total | 6 | |

A description of the recent improvements and modifications of the furnace was published in THE IRON AGE, Dec. 20, 1923.

### Moore Furnaces

The Pittsburgh Electric Furnace Corporation, Pittsburgh, reports a total of 73 furnaces installed or under contract at the close of 1923 in the United States and Canada. Assuming the total of 52, credited in the annual review of this industry in THE IRON AGE, Jan. 4, 1923, to be correct, the additions for 1923 were 21 furnaces. Some of these are reported by the company as follows:

Crucible Steel Casting Co., Milwaukee, Wis.
Saw-Brook Steel Casting Co., Cincinnati.
American Manganese Steel Co., Chicago.
Standard Steel Car Co., Pittsburgh.
A. O. Smith Corporation, Milwaukee, Wis.
Otis Elevator Co., Buffalo, N. Y., (replacing 2 Snyder).
Texas Steel Co., Fort Worth, Texas.

This company has under contract three furnaces for installation in other countries than the United States and Canada, making a total of seven furnaces in such countries.

### Greaves-Etchells Furnaces

Installations and contracts during 1923 for Greaves-Etchells furnaces, as announced by the Electric Furnace Construction Co., Philadelphia, include the following:

| | | |
|---|---|---|
| *Greaves-Etchells:* | | |
| Ford Motor Co., River Rouge Plant, Dearborn, Mich. | 2 | (10-ton) |
| Ford Motor Co., River Rouge Plant, Dearborn, Mich. | 1 | (60-ton) |
| *Three-Top Electrodes:* | | |
| Dodge Steel Co., Philadelphia | 1 | (1-ton) |
| | Cast Iron | |
| Owens Bottle Co., Toledo, Ohio | 1 | |
| Total | 5 | |

The installation at the Dodge Steel Co. of the new type of furnace was designed to produce one ton of steel per hour, but in actual operation it is stated to be averaging 4200 to 4400 lb. per hr.

### Greene Furnaces

Changes in the list of electric furnaces, installed or contracted for, as published in THE IRON AGE Jan. 4, 1923, are reported by the Greene Electric Furnace Co., Seattle, Wash., as follows:

| | | |
|---|---|---|
| | Steel Castings | |
| Wallace Foundry Co., Ltd., Vancouver, B. C. | 1 | (1-ton) |
| Sumner Iron Works, Everett, Wash. | 1 | (¾-ton) |
| Greene Steel Casting Co., Berkeley, Cal. | 1 | (¼-ton) |
| Total | 3 | |

The furnace (¼-ton) formerly belonging to the Greene-Shaw Co., Berkeley, Cal., has been taken over by the Greene Steel Casting Co.

One of the furnaces of the Eagle Brass Co., Seattle, Wash., has been taken out and is to be enlarged to make a 500-lb. per hr. iron melting furnace; this leaves a 250-lb. furnace still at that plant.

The 2-ton furnace of the Columbia Steel Corporation, Portland, Ore., announced last year, was put into operation in October, 1923.

### Ludlum Furnaces

The Ludlum Steel Co., Watervliet, N. Y., installed last year

1 ............ 5-ton for steel ingots

### Volta Furnaces

The Volta Mfg. Co., Welland, Ontario, sold last year the following:

| | | |
|---|---|---|
| Welland Electric Steel Castings, Ltd., Welland, Ont. | 1 | (1-ton) Castings |
| Also to foreign countries: | | |
| Imperial Japanese Navy, Japan | 1 | (6-ton) Steel and iron |

These are the only changes in the list as published a year ago in the review already referred to.

The Volta company announces the sale of an electric brass furnace of ¾ ton capacity to the Buffalo Bronze Die Cast Corporation, Buffalo, N. Y.

Reports from other types of furnaces were not obtainable.

### Summary for 1923

The total new installations in the United States, according to the foregoing, is 36 for 1923 or double the number in 1922. Summarized, they are as follows:

| | | | |
|---|---|---|---|
| Heroult | 6 | Greaves-Etchells | 3 |
| Moore (or Pittsburgh) | 21 | 3-Top Electrode | 2 |
| Greene | 3 | Ludlum | 1 |
| Volta | 1 (*Canada*) | | |
| Total 36; Canada 1 | | | |

The record of expansion, as presented by the annual reviews of this industry in THE IRON AGE for the previous 10 years, has been as follows, including the additions last year:

| Period | New Furnaces | Period | New Furnaces |
|---|---|---|---|
| July 1913 to Jan. 1, 1915 | 22 | 1919 | 36 |
| 1915 | 32 | 1920 | 33 |
| 1916 | 63 | 1921 | 32 |
| 1917 | 97 | 1922 | 18 |
| 1918 | 54 | 1923 | 36 |

The expansion last year was therefore equal to the best peace-time record of 36 in 1919.

Assuming no changes in the list of total installations on Jan. 1, 1923, the additions this year would bring the total furnaces in the American industry to 442 on Jan. 1, 1924, as compared with 406 a year ago.

It is known, however, but not in detail, that there have been numerous changes, some furnaces being dismantled, sold or abandoned. Allowing liberally for such changes, and for certain installations not made public, it is a conservative estimate that there are at least 410 furnaces still in existence as capable of active operation.

The Heroult furnace still leads with the largest total, probably 172, with the Moore furnace now easily second at 73. The Greene total is now 30 and the Ludlum 15.

A new furnace introduced last year is the Holcroft, sold by Holcroft & Co., Detroit.

The expansion of the American electric steel industry in 1923 was highly satisfactory and exceeds the expectations of many. It is further evidence of the permanence of the electric process and of the probability of its continued growth.

## Prices of Pig Iron and Other Products

*(Concluded from page 108)*

In this diagram the 1913 price in each instance is taken at 100 per cent. The maximum price in the 1920 upheaval is shown by the total height of each column in the diagram, while the prices of one year ago and today are indicated at an intermediate point. Where the price one year ago was greater than that today, the interval between the two is shown with a diagonal section line. Where the price today is greater than it was one year ago, the interval between the two is shown dotted. Anthracite coal, both this year and last, has been well above the 1920 peak.

In the table will be found the basic prices upon which the index has been computed. These have been gathered from various authoritative sources, both governmental and other, and are the latest data available before going to press.

In a second diagram, tracing the course of certain commodities across the past four years, we have placed THE IRON AGE finished steel composite price and the price of steel beams in comparison with three of the figures reported by the Bureau of Labor Statistics, these being building materials, cloth and clothing, and the "all commodities" price. This last is a weighted average of more than 400 items of wholesale prices, tabulated regularly by that bureau.

Throughout the course of this diagram, with the exception of recent months, steel beams have been consistently below all the other prices shown. The finished steel composite has been consistently below the prices of building materials and of cloth and clothing throughout this range, and for a considerable portion of the time has been below the "all commodity" figure. In recent months, however, this curve has accompanied the steel beam prices in reaching a level higher than "all commodities."

It will be evident from the data in the table and from both diagrams that, as a general proposition, prices of iron and steel are fairly closely in line with the general level of commodity prices throughout the United States. Both the steel items, as well as the pig iron figure, are far below the prices at which certain other commodities are held—particularly those which go in large measure into the immediate consumption of American households.

**High rents and housing costs generally are attributed in large measure to the grasping hand of the building artisan. These charts show that he is not alone to blame, for the materials going into house construction are so much out of line as to form a heavy charge, and account in large measure for the present situation—and steel beams share very lightly in this responsibility.**

| | Prices Quoted | | | | Index Number (1913 = 100) | |
|---|---|---|---|---|---|---|
| Item | Average 1913 | Peak 1920 | One Year Ago | Recent Figure | Peak 1920 | Recent Figure |
| Farm products.. | .... | .... | 143 | .... | 247 | 144 |
| Food, etc....... | .... | .... | 143 | .... | 248 | 148 |
| Cloth and clothing .......... | .... | .... | 192 | .... | 346 | 199 |
| Fuel and lighting | .... | .... | 218 | .... | 281 | 172 |
| Metals and metal products ..... | .... | .... | 133 | .... | 203 | 142 |
| Building materials .......... | .... | .... | 185 | .... | 300 | 182 |
| Chemicals and drugs ........ | .... | .... | 127 | .... | 213 | 129 |
| House furnishings ......... | .... | .... | 179 | .... | 275 | 183 |
| Miscellaneous .. | .... | .... | 122 | .... | 208 | 120 |
| All commodities. | .... | .... | 156 | .... | 247 | 153 |
| FINISHED STEEL ...... | 1.663c. | 3.974c. | 2.439c. | 2.775c. | 239 | 167 |
| PIG IRON (composite) ...... | $14.70 | $47.84 | $25.79 | $21.88 | 325 | 149 |
| STEEL BEAMS | 1.50c. | 3.10c. | 2.00c. | 2.50c. | 207 | 167 |
| *Fuels* | | | | | | |
| Bituminous coal. | $1.34 | $10.00 | $3.75 | $2.00 | 746 | 149 |
| Anthracite coal.. | 3.82 | 8.00 | 9.25 | 10.81 | 209 | 243 |
| Furnace coke.... | 2.41 | 17.75 | 8.00 | 4.00 | 735 | 166 |
| Penna. petroleum | 1.79 | 6.10 | 3.00 | 2.69 | 341 | 151 |
| Gasoline ....... | 16.8c. | 31c. | 25c. | 19.1c. | 185 | 114 |
| *Building Materials* | | | | | | |
| Yellow pine .... | $28.50 | $67.50 | $53.00 | $59.00 | 237 | 207 |
| Red brick....... | 6.20 | 19.85 | 13.74 | 14.69 | 320 | 216 |
| Lime .......... | 4.43 | 11.85 | 8.89 | 9.90 | 268 | 239 |
| Shingles, red cedar ........ | 1.97 | 6.57 | 3.63 | 2.64 | 334 | 134 |
| Plate glass..... | 31.8c. | 82c. | 61c. | 73c. | 258 | 229 |
| *Textiles and Clothing* | | | | | | |
| Raw cotton..... | 12.84c. | 43.75c. | 26.86c. | 36.30c. | 341 | 283 |
| Sheeting ....... | 7.3 | 28.5 | 12.0 | 14.8 | 390 | 202 |
| Raw silk........ | $3.65 | $16.25 | $8.35 | $7.75 | 445 | 212 |
| Worsted suitings | 1.38 | 5.42 | 2.70 | 3.26 | 392 | 236 |
| Women's shoes.. | 2.17 | 8.25 | 4.23 | 4.15 | 379 | 191 |
| *Foods* | | | | | | |
| Mess pork...... | $20.93 | $47.00 | $29.00 | $25.50 | 225 | 122 |
| Smoked hams... | 16.60 | 37.70 | 23.50 | 22.30 | 227 | 134 |
| Potatoes ....... | 61.4c. | 4.43c. | 2.00c. | 1.71c. | 721 | 167 |
| Flour .......... | 4.61 | 16.25 | 7.65 | 6.25 | 353 | 136 |
| Milk ........... | 3.5c. | 8.5c. | 6.9c. | 8.1c. | 243 | 182 |

## Carnegie Safety Calendar the Work of Pupils in Mill Towns

The Carnegie Steel Co. has put out a calendar for 1924 that has a remarkable appeal as safety propaganda, but a more remarkable one on the score of human interest and employee cooperation. The idea of a safety calendar took form early in 1923 when the company's safety committee arranged a safety poster contest in the public and parochial schools of the 13 mill communities. The contest closed in May. Three cash prizes were given in each community in sums of $25, $15 and $10. Approximately 7500 posters were entered in the contest, and the judging was individual in each community. The work of the young people was of such a high character and the ideas of what safety meant were so well illustrated that it was decided to put out a calendar.

There are thirteen pages, one for each month and the outside or cover page. Each bears an exact reproduction of the poster drawn by a school child, and selected for this purpose. Each plant, too, is represented on one of the pages. Every line of the child's work is carried out and every color maintained by a five color process. A portrait of each child appears by the side of his or her poster in the calendar, with his or her name, age, grade, and school, and home community, thereby carrying a brief sketch of the child artist. The ages ranges from 12 to 19 and most of the calendar posters are the work of high school pupils. A copy of the calendar is being given to each Carnegie employee.

Much interest was taken by school officials in the poster contest, and in some communities the art instructors will make this feature a part of the school work each year henceforth. There also has been a request from these officials for another such contest which will be put on some time in the school year by each of the communities. In addition, all the schools of Pittsburgh will enter a safety poster contest, instead of a few, as heretofore, in the neighborhood of Carnegie Steel Co. plants.

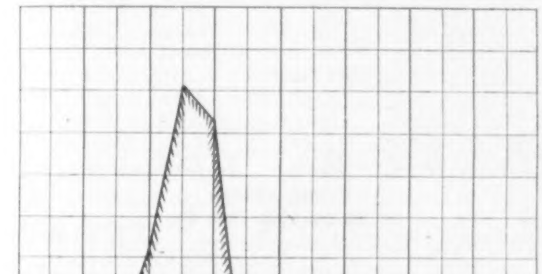
## Merger Plan of Belfont Iron Works Co. and Kelly Nail & Iron Co. Approved

At a meeting of the stockholders of the Belfont Iron Works Co. and the Kelly Nail & Iron Co., held at Ironton, Dec. 28, plans for the merging of the two properties were approved, and details will be worked out and submitted for ratification at a meeting to be held Jan. 16. An independent appraisal of the two properties has been completed, and by the terms of the merger the stock of both companies will be figured in the consolidation on the basis of this appraisal. It is the plan of the merged companies to erect an open-hearth plant at Ironton, and some new financing will be necessary. This new stock will be offered to present holders in proportion to the number of shares now held. It is expected that details of the consolidation will be completed within the next two weeks, and that the new organization will be launched at the meeting to be held Jan. 16.

# Railroads Large Buyers of Machine Tools

## Automobile Industry Also Contributed Important Share of 1923 Business—Average Tool Production for Year 36.5 Per Cent

RAILROADS and automobile and automobile parts manufacturers furnished a large share of the 1923 business of the companies building machine tools. Taking the past year as a whole it was the most satisfactory for many machine-tool companies since the war, although the volume of business did not reach the totals which made up the high records of the first quarter of 1920. March was the high spot in the number of orders placed. According to available figures the volume booked that month was approximately 58 per cent of the total for March, 1920, which was a month of unusually large business. Orders tapered off in April, May, June and July of last year, but in August a flurry of buying was experienced, followed by a further slackening in September to approximately 29 per cent of shop capacity. There was a slight improvement in October and November, the year closing with about 32 per cent of shop capacity being utilized.




A Dealer in Machine Tools Whose Territory Extends Over Several of the Most Important Industrial States has Furnished the Above Chart of His Sales for the Period From 1916 to 1923, Inclusive, Showing the Variations in the Volume of Machine-Tool Sales Over That Eight-Year Period

Although some companies were working at full capacity at times during the year, the industry as a whole did not go above 36.5 per cent average operation for the twelve months. The interesting conclusion has been reached by statisticians of the machine-tool industry, based upon records for the past few years, that the curve of machine-tool demand very closely approximates that of pig iron demand.

Most of the 1923 machine-tool business came in the first six months, the tapering off since April being in line with the falling off in demand for pig iron which set in about that time.

Two classes of machine-tool builders have prospered above the average during the past year—those that specialize in heavy types of tools for railroad shop work and those making special production machinery especially adapted to the mass production of the automobile industry.

Buying by automobile companies has been featured by some large purchases, notably those of the Ford Motor Co. for an extensive enlargement of its productive capacity, and nearly all of the automobile builders and the makers of parts and accessories have been steady buyers during most of the year. The railroads have as a rule followed their usual custom of purchasing large lots of shop equipment, although there has been also a good deal of scattered buying by the carriers.

Outstanding among the purchases of the railroads were the following items: New York Central Lines, $350,000; Southern Pacific, $400,000; Central Railroad of New Jersey, $150,000; Lehigh Valley, $80,000; Delaware, Lackawanna & Western, $30,000; Chicago, Burlington & Quincy, $250,000; Missouri Pacific, $225,000; St. Louis-San Francisco, $150,000; Canadian National Railways, $500,000; Illinois Central, $325,000; Union Pacific and Oregon Short Line, $125,000; Chicago & North Western, $175,000; Santa Fe, $325,000; Denver & Rio Grande Western, $275,000; Elgin, Joliet & Eastern, $100,000; Pere Marquette, $200,000.

These figures, of course, are in round numbers and are merely estimates of leading companies in the machine-tool trade which specialize in railroad shop equipment. The Middle Western territory—comprising those roads whose purchases are made at Chicago, Milwaukee and St. Louis—was the center of railroad purchasing of machine tools. It is estimated that railroad purchases for the year in that district alone reached a total of $4,000,000.

Nearly all of the American railroads have bought some new equipment, among others that have been extensive buyers being the Texas & Pacific, Chicago, Milwaukee & St. Paul, Louisville & Nashville, Central of Georgia, Rock Island Lines, the Big Four, the Maine Central, Akron, Canton & Youngstown, New York, Ontario & Western, New York, New Haven & Hartford, Michigan Central, Nickel Plate, Southern Railway and Pennsylvania Lines.

Railroad equipment companies, such as the Baldwin and American locomotive companies, Union Switch & Signal Co. and others in similar lines, were also extensive buyers, the Baldwin Locomotive Works having bought fully $250,000 worth of new tools.

Nearly all of the metalworking industries were fairly active buyers during the first quarter of the year, but the next eight or nine months showed a gradual decline in general buying. The market for used tools was fairly satisfactory throughout the year, such machines being offered at prices which at times made serious competition for new tools.

Prices were advanced rather generally during the first quarter of 1923, under the stimulus of large demand and rising costs of production, and during a large part of the year remained at the levels then fixed, there having been comparatively few reductions. On the average, machine-tool selling prices at the close of 1923 were just about double the pre-war "normal" of 1913.

# Current Metal Prices

**On Small Lots, Delivered from Merchants' Stocks, New York City**

The following quotations are made by New York City warehouses.

As there are many consumers whose requirements are not sufficiently heavy to warrant their placing orders with manufacturers for shipments in carload lots from mills, these prices are given for their convenience.

On a number of items the base price only is given, it being impossible to name every size.

The wholesale prices at which large lots are sold by manufacturers for direct shipment from mills are given in the market reports appearing in a preceding part of THE IRON AGE under the general heading of "Iron and Steel Markets" and "Non-Ferrous Metals."

### Iron and Soft Steel Bars and Shapes

Bars:
- Refined iron bars, base price .................3.54c.
- Swedish charcoal iron bars, base.....7.00c. to 7.25c.
- Soft steel bars, base price ..................3.54c.

Hoops, base price ..........................5.19c.
Bands, base price ..........................4.39c.
Beams and channels, angles and tees, 3 in. x ¼ in. and larger, base ......................3.64c.
Channels, angles and tees under 3 in. x ¼ in., base ....................................3.54c.

### Merchant Steel

| | Per Lb. |
|---|---|
| Tire, 1½ x ½ in. and larger | 3.60c. |
| (Smooth finish, 1 to 2½ x ¼ in. and larger) | 4.10c. |
| Toe-calk, ½ x ⅜ in. and larger | 4.60c. |
| Cold-rolled strip, soft and quarter hard | 7.50c. to 8.50c. |
| Open-hearth, spring steel | 4.50c. to 7.50c. |
| Shafting and Screw Stock: | |
| Rounds | 4.40c. |
| Squares, flats and hex | 4.90c. |
| Standard tool steel, base price | 15.00c. |
| Extra tool steel | 18.00c. |
| Special tool steel | 23.00c. |
| High speed steel, 18 per cent tungsten | 75c. to 80c. |

### Tank Plates—Steel

¼ in. and heavier ..........................3.64c.

### Sheets

*Blue Annealed*

| | Per Lb. |
|---|---|
| No. 10 | 4.34c. |
| No. 12 | 4.39c. |
| No. 14 | 4.44c. |
| No. 16 | 4.54c. |

*Box Annealed—Black*

| | Soft Steel C. R., One Pass Per Lb. | Blued Stove Pipe Sheet Per Lb. |
|---|---|---|
| Nos. 18 to 20 | 4.40c. to 4.70c. | ..... |
| Nos. 22 and 24 | 4.45c. to 4.85c. | 5.10c. |
| No. 26 | 4.50c. to 4.90c. | 5.15c. |
| No. 28 | 4.60c. to 5.00c. | 5.25c. |
| No. 30 | 4.80c. to 5.20c. | ..... |

No. 28 and lighter, 36 in. wide, 20c. higher.

*Galvanized*

| | Per Lb. |
|---|---|
| No. 14 | 4.70c. to 5.10c. |
| No. 16 | 4.85c. to 5.25c. |
| Nos. 18 and 20 | 5.00c. to 5.40c. |
| Nos. 22 and 24 | 5.15c. to 5.55c. |
| No. 26 | 5.30c. to 5.70c. |
| No. 27 | 5.45c. to 5.85c. |
| No. 28 | 5.60c. to 6.00c. |
| No. 30 | 6.05c. to 6.45c. |

No. 28 and lighter, 36 in. wide, 20c. higher.

*Welded Pipe*

| Standard Steel | Black | Galv. | Wrought Iron | Black | Galv. |
|---|---|---|---|---|---|
| ½ in. Butt... | —41 | —24 | ½ in. Butt... | — 4 | +19 |
| ¾ in. Butt... | —46 | —32 | ¾ in. Butt... | —11 | + 9 |
| 1-3 in. Butt.. | —48 | —34 | 1-1½ in. Butt. | —14 | + 6 |
| 2½-6 in. Lap. | —44 | —30 | 2 in. Lap.... | — 5 | +14 |
| 7-8 in. Lap. | —41 | —11 | 2½-6 in. Lap. | — 9 | + 9 |
| 9-12 in. Lap.. | —34 | — 6 | 7-12 in. Lap.. | — 3 | +16 |

### Steel Wire

BASE PRICE* ON NO. 9 GAGE AND COARSER

| | Per Lb. |
|---|---|
| Bright basic | 4.75c. to 5.00c. |
| Annealed soft | 4.75c. to 5.00c. |
| Galvanized annealed | 5.40c. to 5.65c. |
| Coppered basic | 5.40c. to 5.65c. |
| Tinned soft Bessemer | 6.40c. to 6.65c. |

*Regular extras for lighter gage.

### Brass Sheet, Rod, Tube and Wire

BASE PRICE

| | |
|---|---|
| High brass sheet | 17¾c. to 18¾c. |
| High brass wire | 18¼c. to 19¼c. |
| Brass rods | 15½c. to 16½c. |
| Brass tube, brazed | 25¾c. to 27¼c. |
| Brass tube, seamless | 22 c. to 23 c. |
| Copper tube, seamless | 23½c. to 24½c. |

### Copper Sheets

Sheet copper, hot rolled, 21c. per lb. base.

Cold rolled, 14 oz. and heavier, 3c. per lb. advance over hot rolled.

### Tin Plates

| Bright Tin | Grade "AAA" Charcoal 14x20 | Grade "A" Charcoal 14x20 | Coke—14 x 20 | Prime | Seconds |
|---|---|---|---|---|---|
| | | | 80 lb.. | $6.55 | $6.30 |
| | | | 90 lb.. | 6.65 | 6.40 |
| | | | 100 lb.. | 6.75 | 6.50 |
| IC.. | $12.55 | $10.70 | IC.. | 7.00 | 6.75 |
| IX.. | 13.95 | 12.55 | IX.. | 8.25 | 8.00 |
| IXX.. | 15.55 | 13.75 | IXX.. | 9.50 | 9.25 |
| IXXX.. | 17.10 | 15.30 | IXXX.. | 10.75 | 10.50 |
| IXXXX.. | 18.85 | 16.80 | IXXXX.. | 12.00 | 10.75 |

### Terne Plates

8 lb. coating, 14 x 20

| | |
|---|---|
| 100 lb. | $7.00 to $8.00 |
| IC | 7.25 to 8.25 |
| IX | 8.25 to 8.75 |
| Fire door stock | 9.00 to 10.00 |

### Tin

Straits pig ....................................50c.
Bar ..................................58c. to 60c.

### Copper

Lake ingot ....................................15¾c.
Electrolytic ...................................15¼c.
Casting ........................................14¼c.

### Spelter and Sheet Zinc

Western spelter ................................7¾c.
Sheet zinc, No. 9 base, casks........10½c. open 11c.

### Lead and Solder*

| | |
|---|---|
| American pig lead | 8¾c. to 9c. |
| Bar lead | 10½c. to 12c. |
| Solder ½ and ½ guaranteed | 34¾c. |
| No. 1 solder | 32¾c. |
| Refined solder | 28¾c. |

*Prices of solder indicated by private brand vary according to composition.

### Babbitt Metal

| | |
|---|---|
| Best grade, per lb. | 75c. to 90c. |
| Commercial grade, per lb. | 35c. to 50c. |
| Grade D, per lb. | 25c. to 35c |

### Antimony

Asiatic ..........................11½c. to 12½c.

### Aluminum

No. 1 aluminum (guaranteed over 99 per cent pure), in ingots for remelting, per lb...........36c.

### Old Metals

The market is unchanged and business is very quiet. Dealers' buying prices are nominally as follows:

| | Cents Per Lb. |
|---|---|
| Copper, heavy crucible | 11.00 |
| Copper, heavy wire | 10.25 |
| Copper, light bottoms | 9.00 |
| Brass, heavy | 6.00 |
| Brass, light | 5.00 |
| Heavy machine composition | 9.00 |
| No. 1 yellow brass turnings | 6.25 |
| No. 1 red brass or composition turnings | 8.00 |
| Lead, heavy | 6.25 |
| Lead, tea | 5.25 |
| Zinc | 4.00 |
| Cast aluminum | 16.00 |
| Sheet aluminum | 16.00 |